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POLYPHASE CURRENTS FROM SINGLE ALTERNATING CURRENTS.

We take pleasure in printing in this issue a letter from Mr. Charles S. Bradley, correcting a false impression that may possibly have been produced in the minds of some readers by a recent comment in these columns. The remarks to which Mr. Bradley refers compared true and "split-current" polyphased systems to the disadvantage of the latter, but was in no sense intended to apply to the use of the "split-current" system in the field peculiarly its own—that is to say, as an auxiliary of the simple alternating system. As remarked in the letter, if a self-starting induction motor by this means can be run from a simple alternating circuit, a matter of a few per cent. efficiency is almost entirely negligible in view of the increased profit that would accrue to many hundreds of existing alternating stations through the addition of a day motor load.

THE PHILADELPHIA STRIKE.

The strike now in force of the employees of the Union Traction Company, of Philadelphia, adds to the significance of our remarks of a few weeks ago concerning the wisdom of corporations enjoying public franchises in inviting public displeasure. The lack of diplomacy—to use a mild term—shown in the action of the company which gave occasion to our comment, was again apparent in the unfortunate dealings with the committee of citizens which offered their services with a view to bringing the strike to a close. The matter of the present strike affects other interests than those directly concerned, for the weak position in which the Traction Company has placed itself will be apt to be considered aside from the particular circumstances of the case, and lead to electric railway employees elsewhere thinking that they will similarly have the sympathy of the public in the redress of supposed grievances. It would seem that as soon as the present difficulties are settled the stockholders of the Union Traction Company might well turn their attention to the question whether the management under which so much trouble has been produced should not be radically overhauled.

ELECTRICITY AT THE ATLANTA EXPOSITION.

In another column we print an article from the pen of the engineer of the Atlanta Exposition, giving a complete account of the part played by electricity in connection with the very creditable enterprise that has done so much to bring to the knowledge of the country at large the vigorous industrial spirit which animates the New South. While there is nothing particularly novel about the electrical installation, yet it reflects great credit upon the engineers connected with it. To install a plant consisting of almost 12,500 incandescent, and 500 arc, lamps, in less than 30 days is a feat probably unparalleled in electrical engineering, and is the more noteworthy from the fact that the plans followed, as will be seen from the description, provided for other than a mere perfunctory installation, roughly thrown together. All will agree with Mr. Foster that the custom of leaving to the last moment the matter of provision for the engineering features of expositions like the present one, is a thoroughly bad one, but, we fear, in view of the very efficient manner in which engineers extricate themselves from the consequent difficulties, that there is little promise of reformation in this respect. As will be seen from the views accompanying the article, night decorations are one of the features of the Atlanta show, where they are carried to a greater length than at any previous

exposition. The great growth in this branch of electrical art—for so it may be called—is illustrated in another article in this issue, and at present it is not difficult to imagine the extent of the part it will play in future expositions. It is quite probable that in the future all of the main buildings will be outlined in light, and purely decorative lighting features scattered everywhere about the grounds. As a consequence of the superior attractions of the night that will follow from this, exhibitors will avail themselves of the electric light to attract attention to their wares, and the interior of the buildings will thus present a spectacle whose magnificence can be imagined if we suppose the electrical decorations and signs of New York Christmastide multiplied many hundred-fold, and assembled within the compass of several large buildings.

THE INVENTION OF THE ELECTROMAGNETIC TELEGRAPH.

In our issue of last week the series of articles on "The Invention of the Electromagnetic Telegraph" was brought to a close, thus completing what may be truly considered one of the most valuable contributions yet made to the history of a great subject. What conclusion may be drawn from the discussion depends entirely upon what meaning is given to the word "invention," as used by the various writers. To the reader of the series it is needless to say that it has been employed in a number of senses, which necessarily follows from the wide scope of Morse's activity, and the many elements contained in the telegraph. The title of the series is in itself somewhat of a misnomer, as the claim for Morse of the broad title of "The Father of the Telegraph" forms, directly or impliedly, no small part of the discussion. The various matters considered, in fact, include the conception of the idea of the transmission of intelligence by electricity, the invention of the first practical apparatus for the accomplishment of the idea, and the relative credit to be assigned for the various elements entering into that apparatus, aside from its special mechanism. Taking up the latter point first, it would seem to have been somewhat needlessly introduced, for if special credit is conceded in one instance, it can be claimed in endless succession in others. Claims for participation in the invention of the telegraph based merely upon the inclusion of the electromagnet as one of its parts, are not stronger than would be similar claims for the primary battery also employed by Morse. As credit for the battery would have to be apportioned to all who had part in its development, from Volta onward, so would that due on account of the electromagnet have to be divided with Sturgeon, and in the same category would come other elements of the apparatus. Secondly, as to the priority of conception of the idea of the transmission of intelligence by electricity, it is scarcely necessary to consider at length the claims made for Morse in this connection. Herr Petsch quotes Wheatstone as saying in 1838, that he had then gathered the names of 62 claimants to the invention of the electromagnetic telegraph. Leaving aside, however, the numerous early speculations on the subject, it is to be noted that Sömmering, in 1809, actually constructed an electric telegraph, though an utterly impracticable one ; Ampere, in 1820, and Schilling before 1832, proposed definite forms of electromagnetic telegraphs, though impracticable of execution ; in 1831 Henry in America, and a year later, Gauss and Weber in Germany, had in operation electromagnetic sound telegraphs that did not differ in fundamental principle from that in use to-day, though, as devised, impracticable of commercial application. The claims of Morse date from the year of the latter experiments, but it was not until four years later that his ideas took definite shape, which was also the same year in which Cooke took the Schilling telegraph to England in order to develop it. In 1840 the Cooke and Wheatstone telegraph was first operated, and is to-day largely used in Great Britain. The Morse telegraph was first commercially operated in 1844, and is the telegraph of to-day, though in a modified form and with what the inventor perhaps considered its most important feature omitted—the writing mechanism. We now come to the most difficult question involved in the discussion—the invention of the apparatus itself. That the main principles of the electromagnetic writing telegraph as completed were the conception of Morse alone, cannot, we believe, be denied, and of the three men who assisted in making it commercially practicable, two—Henry and Gale—never claimed to have rendered any inventive assistance, their services having consisted in giving advice with respect to scientific details having no connection with the system considered as an invention. The claims for Alfred Vail, are, however, of a different character, relating, as they do, to the invention of the dot-and-dash alphabet, and the design in great part of the operative details of the apparatus as finally commercially perfected. As to the claim with respect to the former, it was bitterly repudiated by Morse. Morse's unquestioned prior invention of an ingenious sign code for the same purpose is presumptive evidence in his favor ; the alphabet was patented in Morse's name, and in a book written by Vail several sentences occur which, unless a most improbable construction is placed upon their meaning, specifically indicate Morse as the inventor, and with no qualification implying that the writer had any share in the invention. The only independent evidence against this is the testimony of one person, and rests upon his recollection a half century latter of what occurred when he was a lad of fifteen. As to the part played by Vail with respect to the mechanical details of the perfected apparatus, the great changes introduced after he became connected with the matter in 1837, together with what is known to have been his skill in mechanism and the acknowledgment by Morse himself of valuable aid received, all indicate that no small measure of the successful execution of the apparatus was due to him. It is possible that if Vail had not been called in, the Morse telegraph might not have been perfected in time to win the honor of having played the leading part in converting the world to telegraphy, and perhaps might even have been perfected independently of Morse. Giving to Alfred Vail the largest possible meed of credit does not, however, detract from the honor of Morse as the inventor of the essential features of the system, for were credit for all the details, including the dry stylus, accorded to Vail, Morse would yet occupy a similar position with respect to electromagnetic telegraphy that Bell does to telephony, though, of course, with no such exclusive claims for originality. Even if the credit due to Morse for the invention of the system of telegraphy with which his name is associated were restricted to the minimum fixed by those who oppose the claims made for him, he would yet stand out the greatest figure in the pages of telegraphic history, and, it may be added, though perhaps foreign to the present subject, always remain one of the most inspiring examples of indomitable perseverance in the championship of an idea that America has yet produced.

Mr. A. P. Trotter.

Mr. A. P. Trotter, B. A., M. Inst. E. E., formerly editor of the London *Electrican*, has been appointed Government Electrician and Inspector to the colony of the Cape of Good Hope, and will take up his duties there early in the new year.

Right-of-Way Damages.

In the Superior Court of Hartford, Conn., Judge Ralph Wheeler last week handed down a decision in which he says that a real estate owner claiming damages against a trolley company must prove unreasonable occupation of land by such corporation, and must prove also for himself special and not general damages. Should this case be appealed it will raise in the Supreme Court of the State the whole question of the right of adjacent landowners to compensation from trolley companies. The same question is to be raised soon in the Superior Court of New Haven in a case of the New Haven Steam Railway Company against the Fairhaven & Westville Trolley Company, but Judge Wheeler's decision apparently anticipates it, and is the first ruling on the subject in a lower court of the State.

The Buffalo-Niagara Franchise.

Mayor Jewett on Dec. 16 signed the long-delayed franchise governing the introduction of electric power from Niagara within the corporate limits of the city of Buffalo.

The first of the 15 sections of the franchise provides for supervision of the installation of lines, conduits, etc., by the Board of Public Works.

The second section directs that all poles erected and conduits laid by the company to which the franchise is granted, excepting lateral lines extending not more than 2000 feet from a main line of transmission, shall be of such a size and capacity to afford sufficient and suitable facilities for at least one other company, such space and facilities to be equal to the requirements of the company receiving the grant, and not be used by that company for a period of ten years after its acceptance of the present grant. The city shall have the right during these ten years to use such additional space or any part thereof, for any public purpose from which it shall not receive a revenue, free of charge, and having commenced such use may continue upon the same terms for the whole period of the grant. The city may of itself use, or authorize another company to use, the additional space and facilities for other than public purposes upon paying a just proportionate part of the cost of construction, and of altering and repairing the same, together with 6 per cent. interest upon such proportionate part from the time of the investment by the company receiving the present grant. Provision is made for arbitrators in case of a dispute as to the above payments. The application of this proviso extends only over the first period of ten years of the grant, after which time the company receiving the grant may use the additional space and facilities itself if not availed of as above provided. The section also provides that the poles or conduits shall have sufficient additional capacity for certain wires for the city fire and police telegraph.

Section 3 requires that work be done under the supervision, and subject to the approval of, the Board of Public Works, which has authority to restore street openings at the expense of the company, in case a condition exists dangerous to life or property. The next section requires the adoption of such alterations in lines and conduits as at any time in the future may be demonstrated necessary for the better protection of life and property.

Sections 5, 6 and 7 provide, respectively, for putting underground overhead wires, by order of the Common Council; for the use of the poles and conduits of present companies upon the payment of a just compensation therefor, and for making such changes in position of poles or conduits as may at any time be made necessary by city improvements.

Section 8 requires the company to supply current to all persons or corporations desiring the same, situated along its main lines of transmission or within 2000 feet thereof, upon complying with suitable regulations, for which a greater proportionate price shall not be asked than is charged to other consumers in the same city for the same or a less quantity of electricity supplied at the same or a greater distance from its distributing station; and a higher rate shall not be charged than the company receives from other consumers at other points from its Niagara Falls power-house, under the same conditions as noted above. Whenever the company receives applications for power aggregating 1000 hp, to be furnished within a radius of half a mile from any part of the city, the Common Council may order the company to extend its line to supply the current required.

Section 9 provides that the company shall pay into the treasury of the city of Buffalo, 2½ per cent. of its gross receipts from electricity sold under the terms of the present franchise. Section 10 provides that the company shall be prepared to supply 10,000 horse-power to consumers within the city on or before June 1, 1897, and shall be prepared to furnish 10,000 horse-power additional within each successive year thereafter for four years, or as far as the demand may require. The succeeding section places the duration of the grant at 36 years from the date of its acceptance, and provides that at the expiration of 18 years, there shall be a readjustment by arbitration, of the percentage to be paid by the company to the city.

Section 12 provides that the grant shall not be transferable or assignable without the consent of the Common Council, and that the company receiving the grant shall not consolidate or merge with any other company, or enter into any agreement to prevent competition or the reduction in the price of electricity without such consent. It is agreed, however, that upon an application made within six months after the acceptance of the grant, consent may be given for its transfer to a local company organized to carry out its provisions. Section 13 requires the filing of a bond to reimburse the city for any expense incurred to it through digging up streets, loss of life, etc. The two final sections relate to the manner of revocation of the grant and of its acceptance.

The American Institute of Electrical Engineers.

For the first time in some years the regular December meeting of the American Institute of Electrical Engineers was omitted, owing to there being no paper to bring before the Institute.

At the regular meeting of the Council of the Institute last Wednesday, among other business transacted was the reorganization of the Committee on Papers, Meetings and Editing, and the appointment of a committee consisting of Messrs. W. B. Van Zize (chairman), H. S. Carhart, W. F. C. Hasson, A. S. Hibbard, C. T. Hutchinson, T. C. Martin and Townsend Wolcott, to consider the question of the incorporation of the Institute, and report any revision of the constitution that might be necessary or desirable.

The following associate members were transferred to full membership, their applications having been approved by the Board of Examiners:

Messrs. George Stephens, Peterboro, Ont.; George White-Fraser, Toronto, Ont.; Alexander Dow, Detroit, Mich.; Samuel G. Neiler, Chicago, Ill.; L. Knowles Perot, Phœnixville, Pa.; John Balch Blood, Schenectady, N. Y.; Franklin Sheble, Philadelphia, Pa.; William H. Freedman, New York City; Andrew L. Riker, Brooklyn, N. Y., and John A. McCrossan, Rat Portage, Ont.

The Philadelphia Electric Railway Strike.

A general order from the Amalgamated Association of Street Railway Employees was the immediate cause of a strike of the motormen and conductors of the Union Traction Company of Philadelphia, which has almost completely blocked passenger traffic in that city.

The strike went into effect at 4.20 Tuesday morning, Dec. 17, and the first few days the strikers were inclined to be riotous. A certain disreputable element, which is always looking for trouble, was most prominent in the work of destruction. The usual methods of piling obstructions on the track, packing switches, stoning and derailing cars, were resorted to. On Tuesday the police were practically powerless. On Wednesday, however, more decisive steps were taken, and the cars proceeded with less molestation, but under a strong guard. That the striking employees, as a body, did not desire violence, was plainly shown. In several instances conductors and motormen in uniform rushed into the riot and endeavored to stop the destruction which, they complained, seriously injured their cause. As the strike proceeded the rioting grew steadily less.

The Union Traction Company had previously made itself intensely disliked through abolishing free transfers, and almost every third man on the street openly showed his sympathy with the strikers by wearing a placard indicating their intention to walk rather than patronize the Union cars. Public sympathy was with the strikers throughout, and the fact that they refrained from violence strengthened their cause.

The demands made by the employees were substantially as follows: First: Ten consecutive hours shall constitute a day's work, for which $2 shall be paid. Second: All care shall be taken to provide for the physical comfort of motormen. (This refers particularly to vestibules.) Third: Duty on sweepers, snow-plows, and trippers shall be considered special work, for which extra compensation shall be paid. Fourth: No employee shall be discharged for his connection with any labor organization and those recently discharged by reason of such affiliation shall be reinstated.

The loss in wages to the strikers is from $9,000 to $10,000 per day; in receipts to the company, about $30,000 per day. The cars are said to be damaged by rioters to the extent of $10,000, which the city will have to pay.

At 1:30 Friday morning the strike was declared off. The Christian League, a society anxious for peace, and several prominent merchants, among them John Wanamaker, on the strength of a verbal assertion of one of the officials of the road that the company was willing to take back its men and arbitrate, formed a committee and called on the strikers, saying that they were deputed to arrange matters. The strike was, therefore, declared off by the employees, but upon some of them proceeding to the car barns to recommence work, it was discovered that the company repudiated the assurances given as above noted, and the strike was at once renewed with increased vigor. No attempts were made to run cars on Sunday.

The strikers are adopting remarkably intelligent tactics. They have combined with the merchants and are running teams of every description to transport passengers. Five cents is charged, the pro-

ceeds going to the support of the strike, and public opinion being with the strikers, the teams are heavily patronized. The affair has developed into a combined strike of employees and boycott of the public, which apparently the Union Traction Company will find very difficult to overcome. Of the 4500 striking men, the Union Traction Company declares its willingness to take back 3500, the places of the other 1000 having already been filled.

Crompton-D'Arsonval Galvanometer.

The current issues of several of our English contemporaries illustrate a new form of the D'Arsonval galvanometer, due to Mr. R. E. Crompton, the accompanying illustrations of which we borrow from the *Electrician* and the *Electrical Engineer*.

The permanent magnets are of the horseshoe type, built up of four laminations which are secured to the base by the clamping-bolts. Referring to Fig. 1, the bolts are hollowed out to receive a circular coil, *A*, and a circular core, *C*, helps to reduce the resistance of the magnetic circuit. The leveling screws are of a somewhat novel type. They consist of ebonite-headed screws, the ebonite being cone-shaped and stepped to prevent surface leakage.

The connecting wires are brought to the two terminals in the front of the instrument, and the circuit is taken thence to the bifilar attachment by a lead running up inside the central pillar. The details of the bifilar attachment at the top of the central pillar are given in Fig. 2. The attachment takes the form of two conical pins, *P P*, revolving in pillars, *p p*, which are diametrically placed upon an ebonite sleeve, *E*, having a rim with milled surface, and free to turn in the collar of the projecting arm, *A*, cast upon the main sleeve, *S*, encircling the cap, *C*, of the pillar. The sleeve, *S*, is free to revolve around the cap, and when properly adjusted is fixed at the side by the set screw, *s*; the cap itself is capable of being raised and lowered by the milled nut, *N*, shown at the top, and is prevented from turning by a set pin working in a slot in the pillar. The suspension wires, which are of phosphor-bronze, are secured to the pins by being passed through holes and plugged.

The sensibility and period of the instrument is altered by means of the device shown at *B* in Fig. 2, and also in Fig 1. This consists of a thin slip of insulating material, which is carried by an arm attached to a sleeve which is free to move vertically or radially on the central pillar, and which is fixed, when properly set, by a screw at the side. Using the full sensibility of the galvanometer, this slip

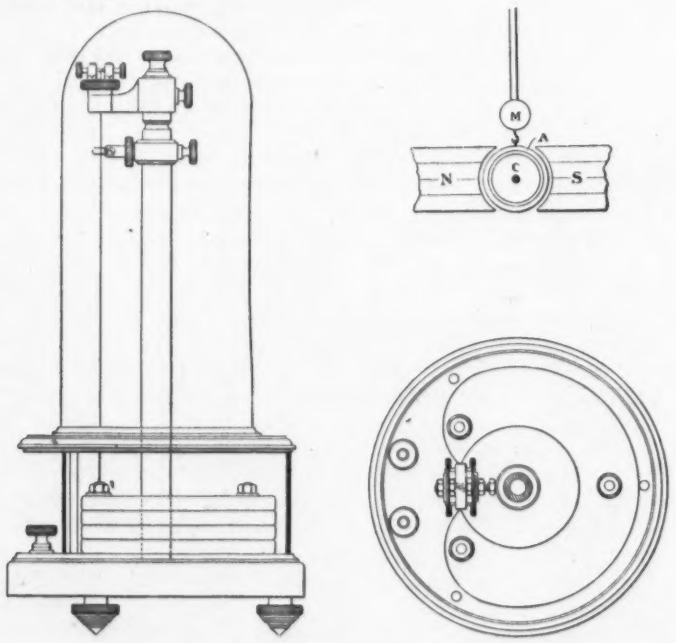


Fig. 1.—Crompton-D'Arsonval Galvanometer.

would lie parallel with the bifilar suspension; by setting the slip at right angles to the bifilar suspension, and raising or lowering the sleeve, both sensibility and period may be adjusted to requirements.

The coil is of the ring type. It is wound upon a wood former, which is subsequently removed, and is suspended by means of two metallic loops at the front and back to two hooks attached to the suspension under the mirror. The movement of the coil is limited by means of undercut washers moved up by nuts. The washers bend the springs, and by adjusting the nut any desired limit can be given to the movement of the coil. These washers and springs can be seen in the plan in Fig. 1.

The terminals are insulated by insulating collars and discs from the base, and are connected by leads running up the centre of pillar to the bifilar attachment. The whole is protected from injury by the brass guard shown, which has a portion cut away in front of the mirror. A sheet of pure plate glass is placed there in order to obtain a well-defined image. A portion even of this glass screen is in some instances cut away, and a disc of microscopic film glass, about one-

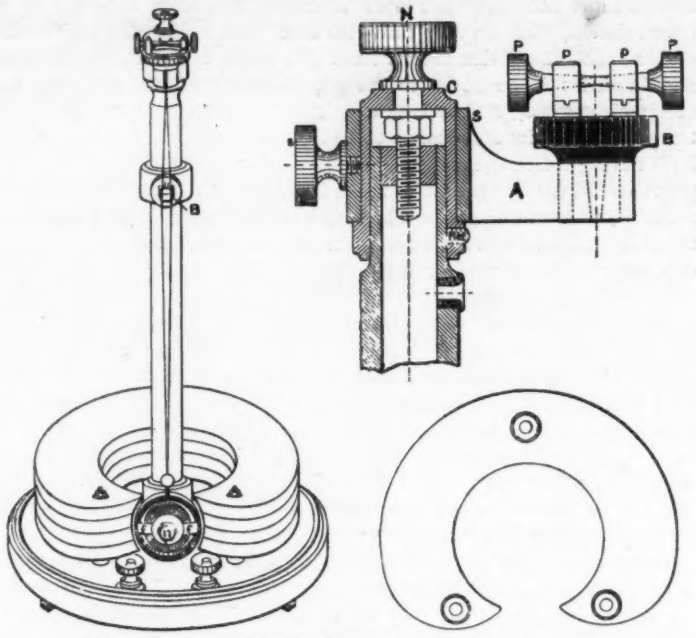


Fig. 2.—Crompton-D'Arsonval Galvanometer.

hundredth of an inch thick, cemented over the opening. The whole is surmounted by a French glass shade.

When the instrument is adjusted for maximum sensibility, one-millionth of a volt will produce a centimetre deflection on a scale 200 cm from the instrument. This voltage is obtained by placing one-hundredth of an ohm in series with 20,000 ohms across an accumulator and attaching the galvanometer leads to the two ends of the small resistance.

Journalism.

Nearly two months ago, Nov. 2, we published in our Digest an abstract of a German article on "Production of Pure Zinc," by Messrs. Mylius and Fromm. Our abstract was reprinted *word for word* in a London electrical contemporary without acknowledgment, although, to the justice of the editor of that journal, we are pleased to be able to add that it was not with his knowledge or consent that credit was not given us. But the amusing feature is that an American electrical contemporary of Dec. 18 now reprints this same abstract word for word from this English journal and gives it credit for it. We are glad to see that the abstract was appreciated and found so interesting, but we would suggest to our American contemporary that it could have obtained the matter from our columns nearly six weeks sooner without waiting until it had traveled the ocean three times. This is not the first time that it has occurred, and we would suggest to this contemporary that if it wants foreign abstracts promptly it will generally find them in our Digest. In still another instance, an American electrical journal printed in its issue of Dec. 15 an abstract of a signed article that appeared in our issue of Nov. 9, credit, however, being given to an English contemporary which had reprinted it.

The "Motor" Company.

An electrical company has been formed in Switzerland and named the "Motor," whose object is to conduct a financial business of all sorts, as far as concerns the procurement of concessions, the construction, operation, reconstruction of installations, the exploitation of processes in electro-technics and electro-chemistry, both in Switzerland and abroad. The company, which will work in co-operation with Messrs. Brown, Boveri & Co., of Baden, Switzerland, has a capital of 3,000,000 francs, of which 600,000 are paid in.

Christmas Electrical Decorations.

CHRISTMAS electrical effects seem to have become a looked-for and an accepted part of the regular holiday display. Last year we told of a few leading devices which were displayed in New York City. This year the display is even more elaborate. The shopping district is fairly ablaze at night with incandescent lamp effects. Up and down the avenues and along the streets the spectacle presents itself in ever varying form. There is always something new to be seen—always some crowd to be found gazing at some especially attractive development in decorative lighting. The rise of the department store has given wonderful opportunity to the genius of makeshift installations, but this only adds to the general result. Incongruous some of them are, and of these we shall speak, but human nature likes incongruity, and hence the displays, which are the most absurd, as far as truthfulness to nature is concerned, have scored the greatest success.

Of course, all the traditional elements which have entered into Christmas celebrations in past ages have been used this year, however modernized they may have become. The Christmas tree is being shown, decked from crown to base with electric lights. Santa Claus, St. Nicholas, or Kris Kringle, has veritably blazed forth this year, loaded down with a stock of incandescent lamps of all shapes, colors and sizes. Not even his reindeer are exempt, nor the once darkened chimney.

One of the most elaborate exhibitions of the year is the immense Christmas tree in the rotunda of Hilton, Hughes & Co.'s department store on Broadway. It is 50 feet high and reaches far up into the rotunda of the building, where it can be viewed in its entirety from the tiers of floors or galleries which surround it. Above the tree, as though it were an immense cap ready to be placed upon it, is an evergreen bell, and above this is a great star of evergreens. The tree and its head pieces have 1650 sixteen candle-power frosted lamps strung upon them. The lamps are interspersed among the branches in all directions. They follow the outline of the bell and the star. In addition, the tree is covered with toys, which have been selected particularly because of their fitness for enhancing the lighting effect. The result is an extremely brilliant effect. The numberless lights in the store itself set off the tree by being in the near vicinity. There is, however, nothing very singular in the equipment of the tree. The wiring is done in a very simple manner. Each limb supports a circuit or section with 10 lights in each. The wires lead into the trunk of the tree, and so on down to the base, where they branch away to plug cut-outs. Each limb is controlled by a separate switch, but there is one main switch at the base, and one lonely workman sits watching it while the tree is lighted in case of accident. It was well that such a precaution was taken, for an accident did occur. The upper portion of the tree toppled and fell, smashing about 600 of the lamps. The watchman, however, had the current cut off before any damage could arise from the accident. The tree, which will be allowed to stand until Jan. 1, was planned by Mr. C. N. Hart, electrician to Hilton, Hughes & Co.

ELECTRICAL CHRISTMAS TREE.

"CHRISTMAS IN THE OLD COUNTRY."

The most elaborate window display wherein electric lamps play an important part is the one made by H. C. F. Koch & Co., of 125th Street. It is called "Christmas in the Old Country," and it has the unique distinction of being the most paradoxical display of the year. Imagine an old English baronial castle with rows of miniature incandescent lamps around each window and turret; in which an inanimate wedding ceremony is taking place, and in which live in happy incongruity two guinea pigs, two English robbins and 26 birds of various shapes, colors and kinds. Imagine also in another wing of the said baronial castle, a Christmas tree celebration, at which guests are constantly arriving in toy wagons, although they may be said to endanger their lives in so doing, because of the caprices of an asbestos snow-storm, which has been imported directly from Paris for the occasion. Still further imagine a beautiful fountain, which in spite of the severity of the weather refuses to freeze up, and you

have something of an idea of the display which is to be seen in the windows of H. C. F. Koch & Co.

As intimated above, this show is a distinct success. The paradoxical element in its make-up seems to take with the crowd, and, in consequence, standing room at the window is constantly at a premium. The electrical equipment of the show consists of 150 3-cp lamps arranged, as stated above, around the windows, and in other nooks and crannies of the baronial castle. The lamps are Jaeger patterns, and are in series of eight with half an ampere of current to each series. They are the product of the Empire Lamp Works, and were made especially for the exhibit.

While these lamps constitute the electrical decorative features of the show, the affair is generally lighted by rows of 16-cp lamps on the ceiling of the window. This is the regular lighting equipment of the window.

A Harlem Crest.

This firm has erected another Christmas decorative electrical feature, which greets the sight of its patrons as they come in the door of the store. It consists of two large shields, on each of which is painted a Christmas scene, and each of which is surmounted by an American eagle, with wings spread. Each shield is surrounded by about 40 incandescent lamps.

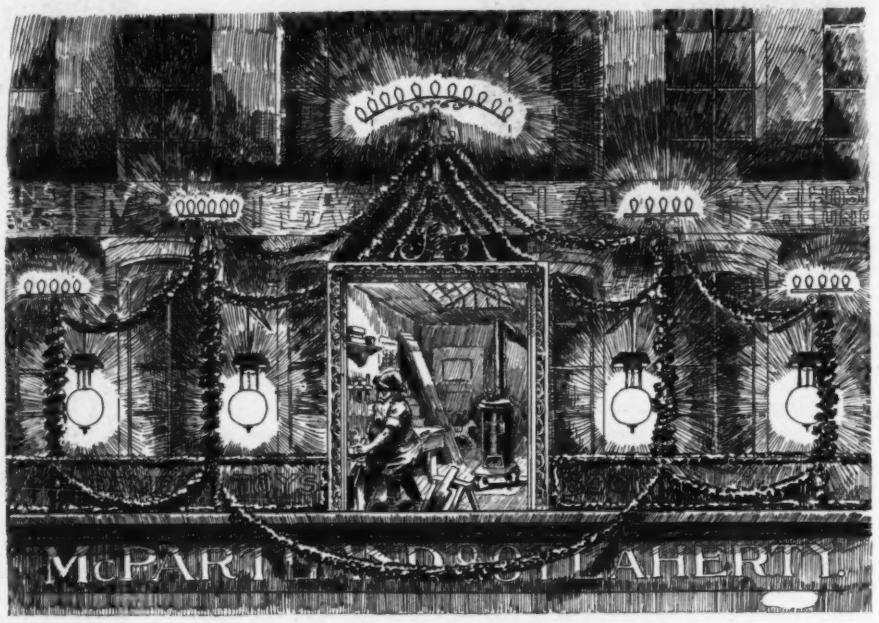
Cosmopolitan Eighth Avenue also has its quota of electrical

Marionette Theatre.

Christmas effects. Eighth Avenue is a well-lighted street on ordinary occasions. Just now it has more than its share of startling effects. Chief among the displays is that in front of the department store of McPartland & O'Flaherty, near Fortieth Street. High up above the main door a staging has been erected. It is a box-like arrangement, with a glass front. Inside of it a series of living pictures are shown, illustrating that much bethumbed juvenile Christmas book, the opening lines of which, well-known in all English-speaking countries, are to the effect that

'Twas the night before Christmas, when all through the house,
Not a creature was stirring, not even a mouse.

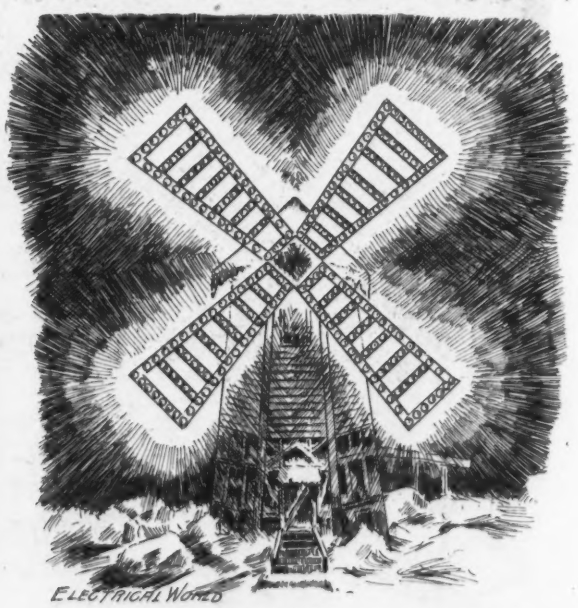
The affair is a panoramic show and has the usual preponderance of head-shakings and wise looks on the part of a youthful Santa Claus, who endeavors to amuse the children, youthful and aged, as



"Living Pictures."

he impersonates the patron saint in the book. The electrical end of the affair consists of rows of specially erected incandescent lamps both inside and outside of the small theatre. Evergreens strung all around the affair help to add something of Christmas cheer.

But we must go to Brooklyn if we would be thoroughly entertained by a Christmas stage performance. In the toy department of Abraham & Straus is a marionette show which is truly unique in its way. The stage on which the performance is shown is 12 feet wide, 6 feet deep and 8 feet high. A minstrel performance is being carried on. The inanimate minstrels are three feet high. The interlocutor occupies as usual the centre chair, and six gorgeously



Electrical Windmill.

arrayed tambourine and bone men sit on each side of him. Wires operate the legs, arms, heads, eyes, and mouths of the figures. The source of motion comes from a shaft attached to an Edison motor. The affair is very realistic. The figures move to the sound of music which

emanates from beneath the stage where real colored men are stationed with banjos and tambourines. The stage, however, is lighted precisely in the manner of a real theatre. There are footlights, borders and bunches, all operated from a little switchboard at the side of the stage. Sixteen-cp lamps are used. There are 10 footlights and 10 border lights, besides other lights in various parts of the apparatus. The affair was conceived by Mr. Katz, of Abraham & Straus, who had the marionettes built for the purpose in Paris. It was built by Samuel R. Boucher, Jr., of Brooklyn, N. Y. The current is supplied from the local plant.

Back in New York again, we find that the shoe store of A. J. Cammeyer has partaken somewhat of the spirit of Christmas cheer. An electrically-lighted windmill, the arms of which are studded with incandescent lamps, is on temporary exhibition in the main window. The affair is 5 feet high. The sails are 4 feet long. The lamps are one cp and there are 300 of them. When the sails revolve, which they do under the influence of a small motor stationed inside, red and white lamps, equally divided over the sails, are alternately thrown into circuit at each quarter revolution of the sails. The windmill is covered with snow and there are lamps inside the building which shine through the windows and produce a very vivid effect. This firm also has erected a new sign on the corner of the building composed of 650 8-cp lamps which tell the public that "Cammeyer stamped on a shoe means standard of merit."

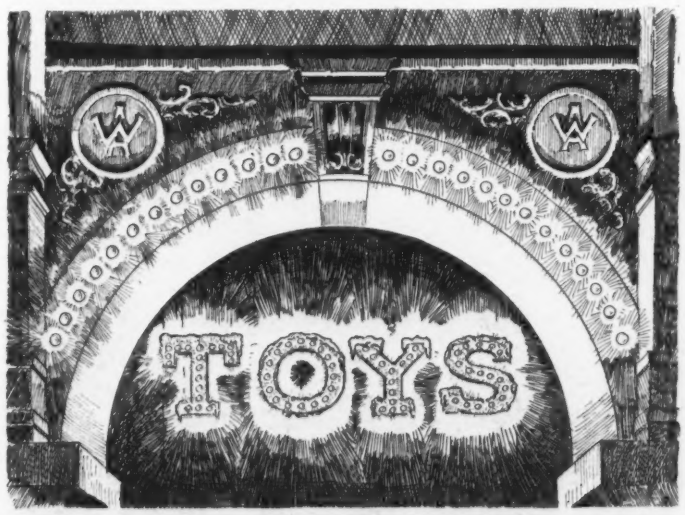
Across the street from Cammeyer's the waving electrical flag of H. O'Neil & Co. shines brightly at night. It was fully described in THE ELECTRICAL WORLD last week, and hence it needs no further mention here except to chronicle the fact that it added to the general display.

We must not forget to mention the arms, or rather the crest, of Messrs. Ehrich Bros. The device consists of a lion rampant beside a red shield, with the monogram of the firm on the shield. The affair is studded with 200 16-cp frosted incandescent lamps. It occupies a conspicuous position on the front of the building. Ehrich Bros. also have a sign beneath this shield, on which their name is made to blaze out from incandescent lamps. The coat-of-arms was designed by Mr. L. W. Seavey, and the installation was made by the Klein Interior Decoration Company.

Brill Bros., at Sixth Avenue and Forty-second Street, have a Christmas scene on exhibition. It is a windmill, snow-covered, and standing in the midst of a mass of toys. The whole is inclosed in a frame of incandescent lamps.

In house decorations there are many devices. The one in front of L. Mannes & Co.'s store in Brooklyn is worthy of mention. Twenty rows of evergreen extend in rays from a central point on the building down over the sidewalk, forming a canopy. Each row carries ten 16-cp lamps of various colors—blue, green, amber, red and white. The arrangement is very attractive.

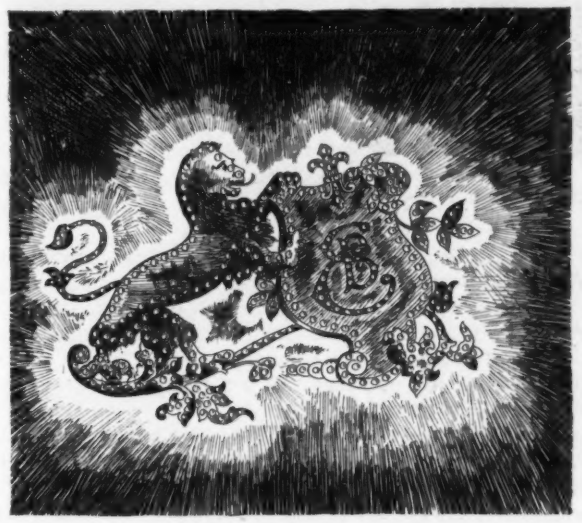
In the Tenderloin all is brilliancy. The unparalleled view north and south from the Thirty-third Street elevated station has often



A BROOKLYN STORE PORTAL.

been commented upon even on ordinary occasions. Just now the spectacle is indeed well worth seeing. All of the theatres which line Broadway at this point have their usual electric signs in nightly operation, and many of them have erected special bits strictly in touch with the spirit of the time. Perhaps the prettiest of them all is the group of lamps in front of the Herald Square Theatre, formed in a legend, which states that the "Heart of Maryland" is being performed there. The name of the play is shown in white 16-cp lamps, but surrounding it is an immense heart composed of ruby lamps of the same candle-power.

Of the private institutions Thorley, the florest, undoubtedly has the prettiest show. Flowers make perforce a handsome background



A SIXTH AVENUE CREST.

for electrical decoration, but in this case the general effect has been aided by the artistic quality of the general design. Thorley's name in frosted incandescent is "written" in Spencerian characters above the doorway. For the Christmas season, however, the florist has placed in his window a Christmas dinner-table set according to his own design. The roof of the window is hung with ferns, and through the ferns sparkle miniature ruby incandescent lamps. The window otherwise is framed with 16-cp frosted globes, so that the electrical equipment is complete. But it is in its entirety that the window must be viewed. The ferns, the opalescent globes, the damask, the parti-colored glasses, etc., make altogether a spectacle that is to be admired and enjoyed.

Near by to Thorley's the words "Waverley Bicycles" shine out from a roof-top in 32-cp incandescent lamps. Further up the street the enterprise of the clothiers, Smith, Gray & Co., is made manifest by their electrical display. The store is on a corner, and in the window is a tall column which is used as a support for the second story of the building. Around this column has been entwined brass electroliers containing an assortment of colored globes. This with the regular electric equipment makes a bright display. On the outside of the building, however, the words, "Smith, Gray & Co." shine out from very small opalescent lamp globes. Loftus, the tailor, also has a colored lamp display and so have others of minor importance. In fact, electrical decoration seems to have been the order of the hour this Christmas.

An Interesting Lantern-Slide Experiment.

At a recent informal lecture at the Engineers' Club of Philadelphia, Dr. Henry Leffmann showed, among other interesting experiments, one which was particularly striking and instructive. A small tank-slide was filled with a solution of sulphate of sodium, colored with an infusion of purple cabbage. It was divided into two compartments by an insulating diaphragm extending down to near the bottom, thus forming two cells, having a connection at the bottom; each of these contained an electrode of platinum. On passing the current, sulphuric acid was formed at one pole and sodium hydrate at the other, the former coloring the solution in its compartment a bright pink or red, and the latter coloring that in its compartment a bright green. With a diaphragm reaching nearly to the bottom, the two solutions can be kept from mixing for quite a while. The purple cabbage solution has the advantage over litmus and other similar coloring matters, that it changes color at both poles, and the colors are very decided.

Electricity at the Atlanta Exposition.

BY CHARLES F. FOSTER.

IN designing an electrical service plant for an exposition, the problems presented to the engineer having such work in charge, are different entirely from those met with in ordinary every-day practice.

In the first place, although the projectors of such enterprises usually take up the consideration of the matter of the service plant at a sufficiently early date, yet such labor and thought as they may put upon it are usually, to a large extent thrown away, for the reason that it is not directed along the proper lines and is not spent with a definite end or plan in view.

Then the selection of an engineer is frequently deferred to a much later date, thus necessitating, to some extent at least, hurried study of the conditions and site ; quick decision of important details, really worthy of careful and extended study ; the hurried building of a large plant, with its invariable consequences of heavy cost due to enormous amounts of overtime and a market drained of necessary material; and, finally, a re-consideration and revision of some of the details of the scheme—most of which troubles and annoyances could have been avoided had earlier selection of an engineer been made.

Furthermore, the changes and growths in requirements at different and often unexpected points change the conditions, after the arrangement has been designed, to such a degree as to entirely discount any allowances which have been made and necessitate a re-arrangement, and frequently a re-assignment, of circuits at the last moment.

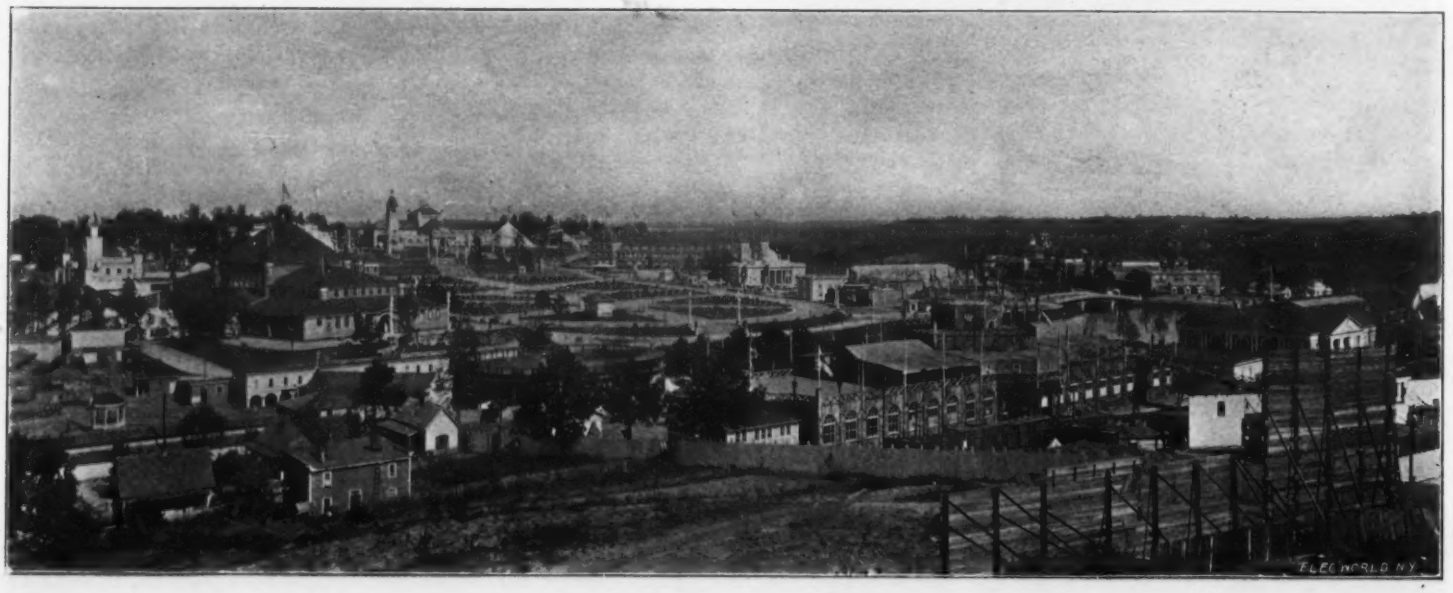
Again, the machinery used is seldom purchased, being nearly always either rented or loaned, each manufacturer furnishing such particular size and type as may best represent his particular views as to what constitutes the best machine of his make. It results from these conditions that the engineer, after the machinery has been secured, finds at his disposal an aggregation of machines of widely differing sizes, capacities and voltages. These conditions are all complicated, the arrangement of the machine and circuits render the construction of the latter much more expensive, and to a great degree reduce the flexibility and interchangeability of the different portions of the system.

Coming so soon after the World's Fair at Chicago, the writer has met with great difficulty in getting machinery at all for the Atlanta service plant, and it was only after determined and long-continued efforts on the part of all concerned that sufficient machinery was secured on such terms as the Exposition Company could accept, and this result was only finally accomplished late in August, less than 30 days previous to the opening day.

As will be noticed on the accompanying view of the grounds, the main buildings are grouped in an irregular circle, with the Grand Plaza in the middle, and the twin lakes at the lower end. The ground rises toward the north from in front of Machinery Building, to the south front of Government Building, and from the Plaza east and west. The result of this arrangement is that from nearly any point within the circle the entire illumination can be seen, so that the lighting of the grounds and buildings appears to the very best advantage.

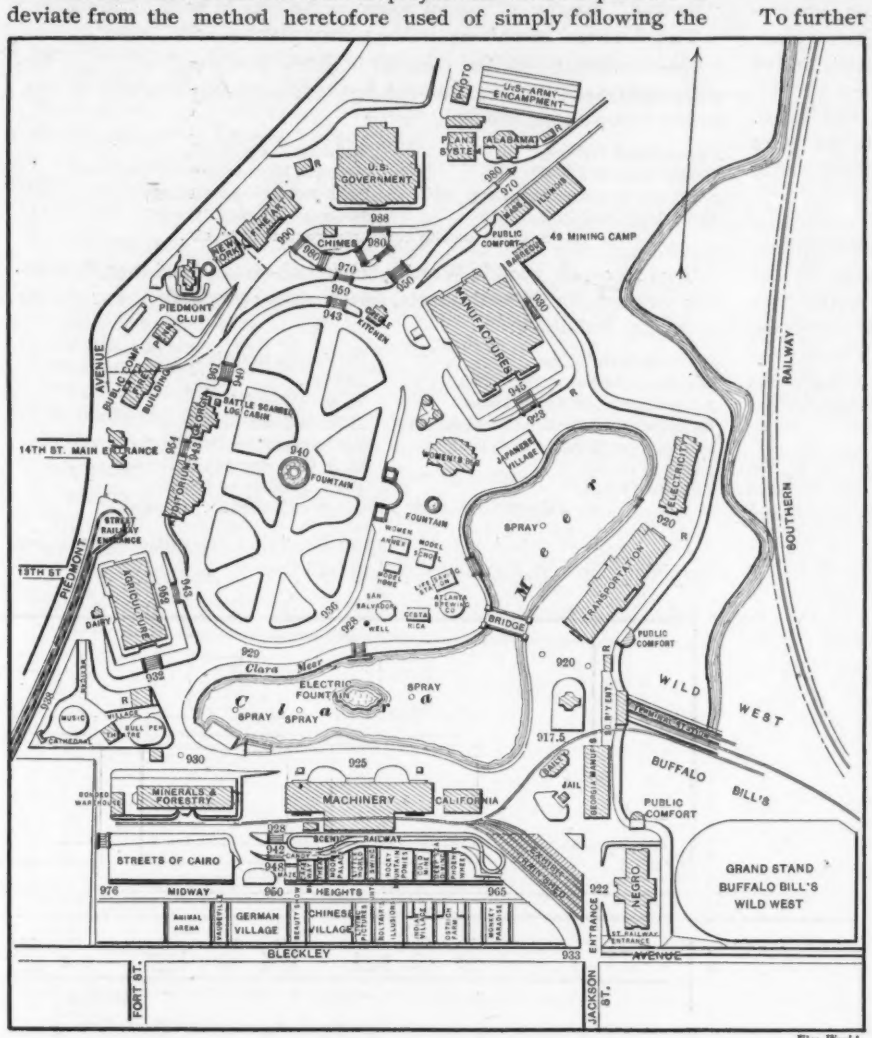
The general scheme of operation for the Exposition which was finally adopted, contemplated closing all the main buildings at night-fall, excepting Art, Electricity and Machinery. This rendered it unnecessary to provide any current inside the remaining buildings at night, excepting that needed for patrol lamps, and for enough extra lamps to bring the windows to a glow. The closing of most of the exhibit buildings rendered it desirable to make the exterior illumination as attractive as possible, and it was, therefore, determined to work on this line, and to add some extra features of special merit.

CHARLES F. FOSTER,
Engineer, Department of Machinery and Electricity.



BIRD'S-EYE VIEW OF EXPOSITION GROUNDS.

Considerations of economy made it impossible to place the lamps, either arc or incandescent, in such close proximity as has been done in previous illuminations, yet for the illumination of the buildings the character of the architecture employed has made it possible to deviate from the method heretofore used of simply following the



PLAN OF EXPOSITION GROUNDS.

cornice lines of the buildings, with a closely placed line of incandescent lamps, and to produce an effect at once varied and pleasing by picking out and accentuating the prominent and distinctive points of each building, without a prodigality of lamps. This will be seen by the views of Electricity and Government Buildings taken at night.

There were installed and are in use 16-cp incandescent lamps in the following services and numbers:

For the exterior decorative lights, Exposition buildings	4896	lamps.
For the exterior decorative lights, exhibitors' buildings	663	"
For the inside buildings, Exposition Company's use	3000	"
For the inside buildings, exhibitors' use	3914	"
Total	12,473	

There were installed, and are in use, arc lamps as follows:

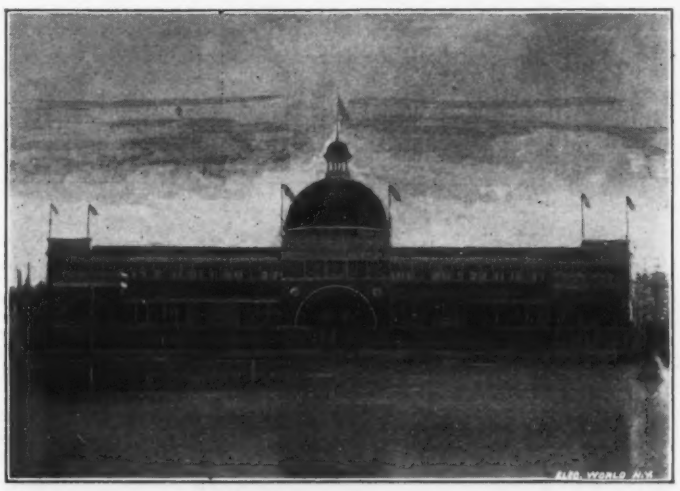
For patrol or all-night circuits	116	2000-cp lamps
For evening circuits inside buildings	137	" "
For evening circuits outside on grounds	223	" "

To further illustrate the varied character of the outside decorative lighting we include a night view of Transportation Buildings.

For special features there was probably the largest and most elaborate electric fountain ever constructed. The fountain was designed by Mr. Luther Stieringer, E. E., specially for the spot where it is placed, in the centre of the larger of the twin lakes, with the intent of making it in harmony with its surroundings.

The fountain, which has been very appropriately named "Atlantis," is exteriorly a representation of a rough, rocky island. It is equipped with 19 extra powerful, focusing, reflecting lamps, and 20 illuminated streams, ranging from ⅜-inch to 1¼ inches in diameter, besides orifices for ring jets, curtains, wheat sheaves and mist bank. Water is supplied to it at the rate of 15,000 gallons per minute at a pressure of 110 pounds, by six Worthington pumping engines situated in Machinery Building, and of varying styles and capacities. While in operation at night the upper portions of the central stream or "Great Geyser," is about 180 feet in height, and illuminated exteriorly by colored lights from the searchlights on the roof of Machinery Building.

Another special and beautiful feature is the "Tower of Light," a massive white shaft 6 feet in diameter and 30 feet high, round, and standing on a square, stepped base. This column is covered by 1000 miniature incandescent lamps, arranged in spirals around it, and with 16-cp lamps on its capital. The column floats on the water at the centre of the east end of the large lake, and its capital is lighted all the evening, the shaft, however, being played at intervals, alternating with the electric fountain. At each end of the electric fountain, and about 150 feet distant, is placed a "pyramid spray" fountain, illuminated at night by a circle of incandescent lamps, floating in the lake, and by the searchlights on Machinery Building. There are four 12-inch projector search-lights used to illuminate the tops of the streams of the electric fountain when in play, and at other times the "Pyramid Sprays" and the statuary around the grounds. The broad steps connecting differing elevations at various points on the grounds, and the statuary on the "Rock Terrace," are illuminated by clusters of 16 incandescent lamps.



ELECTRICITY BUILDING.

ELECTRICITY BUILDING AT NIGHT.

The Southern Railway and the Consolidated Street Railway both have large illuminated signs suspended at their terminal stations, and the former has the exterior of its exhibit building, immediately in front of the terminal, profusely and beautifully illuminated.

These complete the circle of light surrounding the Exposition Grounds.

The general arrangement of the buildings is shown on the accompanying plan of the grounds, and the arrangement of the machines on the plan of the power-plant.

The grouping of the buildings in a rough circle offers an opportunity for a very simple system of wiring, which fact was taken advantage of by running all the main circuits around the outside line of the park, on a heavy pole line, dropping off in the rear of each building, with such capacity in the incandescent as was needed for it. All the circuits, both arc and incandescent, passing within the space enclosed by the buildings, are carried underground, and not a wire appears in sight.

The arc circuits are operated under somewhat different conditions from what has been the case heretofore, due to the fact that it is largely underground, and that all the machines are of 125-light capacity; all being loaded to capacity, the voltages are high, and the writer does not know of any attempt having been made previously to carry currents of 6500 volts intensity underground. The results have been very satisfactory, however, since the troubles due to new machines and lamps, and new and necessarily hurried work, have been eliminated.

For the underground work No. 6 copper wire, coated with best rubber insulation, double braided and protected with heavy lead sheath, was used throughout. The complete cable weighs one pound per running foot, was manufactured and put in place by the Safety Insulated Wire & Cable Company, of New York, and has given the best of satisfaction. The cable was "pulled in" to a square box or duct, made on the ground, of ⅞-inch dressed pine, 4 x 6 inches in cross-section. This duct was placed, with its cover, 18 inches below the surface of the ground, and where necessary, four and six ducts were laid in the same trench. Man-hole or junction boxes were placed at proper intervals and at angles. Hollow wooden lamp posts with ornamental iron frames and hoods were used throughout.

There is nothing particularly different from the ordinary practice in the wiring of the incandescent and power circuits. On the pole-line largely "weather-proof" was used, but inside the buildings nothing but "rubber-covered" was permitted. All the incandescent current is alternating, and the necessary converter capacity is "banked," usually on special poles, in the rear of each building.

The electrical machinery in the power plant is as follows:

One 1150-volt, 250-kw General Electric monocyclic machine, furnishing current for incandescent lights, alternating arcs and power, in the following buildings:

Department Offices,	Exhibit Train Shed,
Negro Building,	Georgia Manufacturers' Building,
Southern Railway Building,	Transportation Building,
Electricity Building,	Midway Heights,

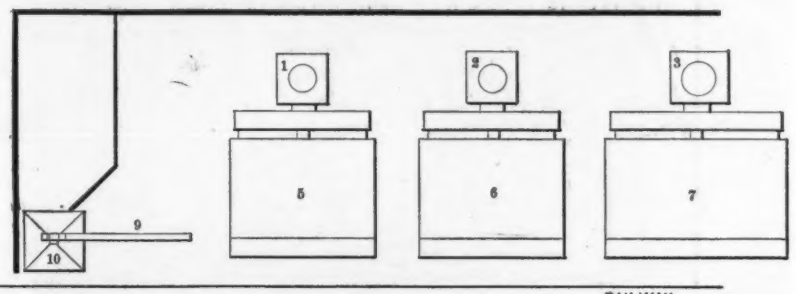
Several public comforts, restaurants, etc.

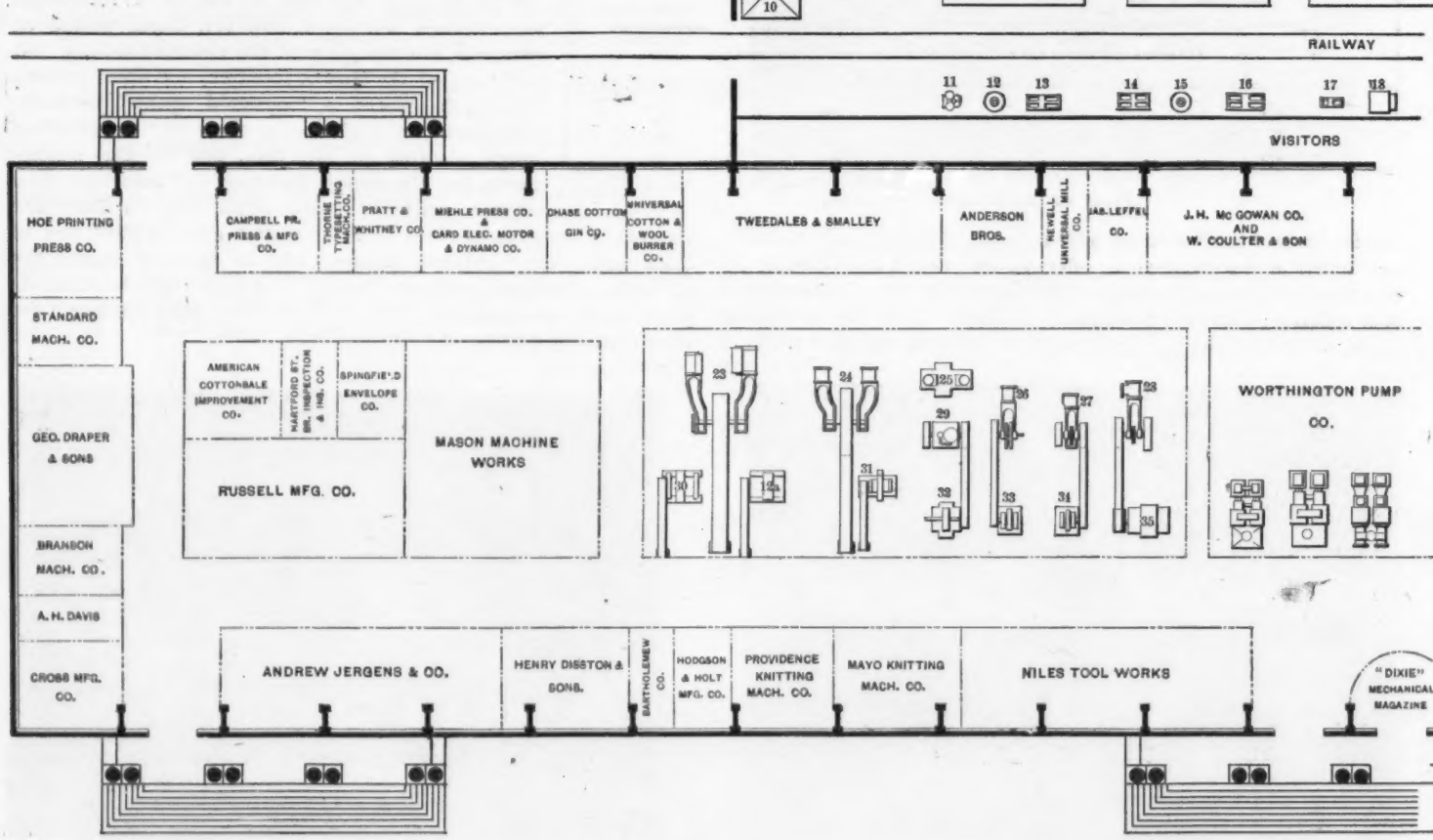
Two 2000-volt, 120-kw Westinghouse two-phase machines, furnishing current for incandescents, alternating arcs and power in the following buildings:

Machinery Building,	California Building,
Southern Railway Terminal,	Bridge,
All buildings on small Plaza,	Woman's Building,
Manufacturers' and Liberal Arts,	Illinois State Building,
Massachusetts State Building,	Alabama State Building,
Plant System,	U. S. Government Building,
Chimes Tower,	Rock Terrace and Steps,

And a number of small buildings and outdoor exhibits.

One 1000-volt, 160-kw Fort Wayne Electric Corporation generator, furnishing current for the following buildings:





POWER

1. Lavatories, etc.
2. Smoke Stacks.
3. Boilers, 2250-hp Stirling Boiler Co., Chicago.
4. Ash Conveyor, Jeffrey Mfg. Co., Columbus, O.
5. Ash Hopper.
6. Pump, Henry R. Worthington, New York.
7. Water Heater, C. P. Adams, Cleveland, O.
8. Pump, Worthington.
9. Pump, Worthington.
10. Water Heater, Excelsior Heater Co., Chicago.
11. Pump, Worthington.
12. Pump, J. H. McGowan Co., Cincinnati.
13. Water Heater, Harrison Safety Boiler Works, Philadelphia.
14. Pump, Laidlaw & Dunn Co., Cincinnati.
15. Pump, Deane Steam Pump Co., Holyoke, Mass.
16. Water Heater, Taunton Locomotive Mfg. Co., Taunton, Mass.
17. Pump, A. S. Cameron Steam Pump Works, New York.
18. Main Steam Header.
19. Visitors' Gallery.
20. 300-hp, Buckeye Engine Co., Salem, O.
21. Condenser, Conover Mfg. Co., New York.
22. 150-hp, Houston, Stanwood & Gamble, Cincinnati.
23. 80-hp, Direct Connected to Generator, Lane & Bodley Co., Cincinnati.
24. 125-hp, American Engine Co., Bound Brook, N. J.
25. 125-hp, Straight Line Engine Co., Syracuse, N. Y.
26. 125-hp, Ball Engine Co., Erie, Pa.
27. 150-hp, Frick Co., Waynesboro, Pa.
28. 200-hp, Jenney Electric Co., Indianapolis.
29. 200-kw, General Electric Co., Schenectady, N. Y.
30. 125-Light, Excelsior Electric Co., Brooklyn, N. Y.
31. 125-light, Fort Wayne Electric Co., Fort Wayne, Ind.
32. 125-light, Brush Electric Co., Cleveland, O.

Machinery Building Basement,
Mexican Village,
Auditorium,
Georgia State Building,
Pennsylvania State Building,
Art Gallery,
Forestry Building,
Agricultural Building,
Administration Building,
Fire Building,
New York State Building,
Street railway terminal and various restaurants and public comfort buildings.

One 2000-volt, 60-kw Standard Electric alternator: This machine has been held in reserve, and has been put into service a few times after midnight as necessity required.

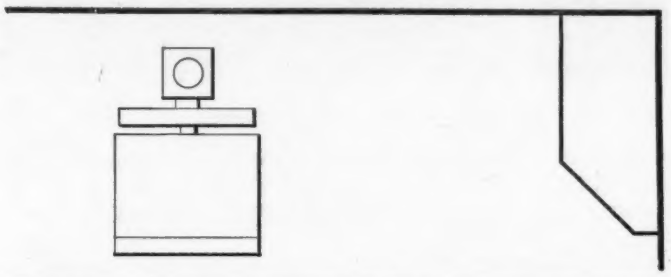
One 1000-volt, 60-kw T.-H. alternator: This machine has carried the load from midnight on, and since Dec. 1 has been started up at 4 o'clock, carrying the Midway lights on until closing down of the night show, and then carrying the night load from this time on until morning.

The arc light plant consist of the following:

Two 125-light, 2000-cp Brush machines.
One 125-light, 2000-cp Fort Wayne machine.
One 125-light, 2000-cp Excelsior machine.
One 35-light, 2000-cp T.-H. machine.

The complete installation comprises 475 arc lamps, all of which are wired in series of from 50 to 60 lamps, two of which circuits are again plugged in series on the switchboard, making the voltage across the terminals of the machines from 5000 to 6500 volts.

Taking into consideration that at present manufacturers carry only stock materials, such as wire, hood-boards, etc., designed and used for currents of 2500 to 3000 volts potential, and the additional fact that time did not permit the designing and building of special materials, the department is to be congratulated upon the success of the installation.



For power generators, there are

One 200-hp, 500-volt, D. C. multipolor Jenney machine.
One 300-hp, 500-volt, D. C. multipolar T.-H. machine.
One 65-hp, 125-volt, D. C. multipolar Card machine.
One 175-hp, 125-volt, D. C. Edison bipolar machine.
One 40-hp, 125-volt, D. C. multipolar Westinghouse machine.

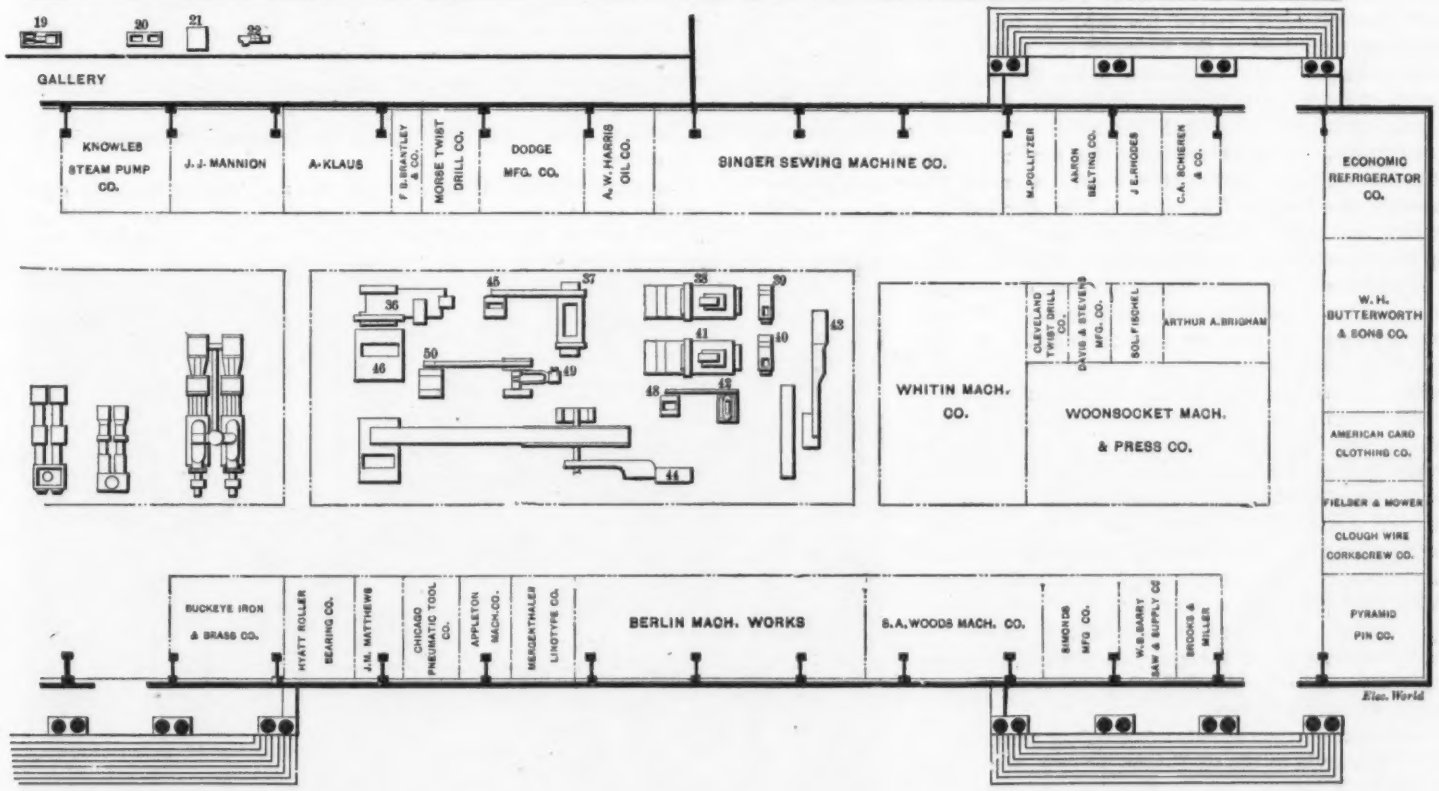
The two first named are used interchangeably to furnish current for motors scattered everywhere throughout the grounds. The Card machine supplies light and power to the "Ferris Miniature World's Fair," while the Edison bipolar machine is used exclusively for the powerful lamps in the electric fountain "Atlantis," the four projector search-lights on the roof of Machinery Building, and during the night after the Exposition closes, for charging the storage batteries of the electric launches.

The great difficulty experienced in securing the machinery, of all kinds, necessary to construct the service plant, postponed to a very late date the day when the actual construction began. Work on the foundations was commenced on Aug. 5, and from that date forward, the work was pushed night and day until Sept. 18, the "opening day," found the plant practically completed.

Considering the location of the Exposition, miles distant from any well-stocked market, the unfamiliarity of all local mechanics with work of this size and character, and the general inferiority of the labor obtainable, together with many other obstructions and annoyances, the construction of a plant of this size and extent, in the time mentioned is an achievement to be proud of, and the department is to be congratulated upon its success.

Electricity Building.—The service plant itself is a complete and varied exhibition of the principal types of electrical apparatus in actual service, and, as in thus exhibiting the manufactures, the principal electrical companies had gone to large expense, it was extremely difficult to induce any of them to make another exhibit in Electricity Building.

Continued and determined work, however, was successful, and the building was finally filled. Time and space do not permit any



PLANT.

33. 125-light, Brush.
34. 150-kw, Edison.
35. 300-hp, Harrisburg Foundry & Machine Works, Harrisburg, Pa.
36. 100-hp, Gas Engine, J. J. Case Threshing Machine Co., Racine, Wis.
37. 160-hp, Westinghouse Electric & Manufacturing Co, Pittsburg, Pa.
38. 160-hp, Westinghouse.
39. 5-hp, Westinghouse.
40. 5-hp, Westinghouse.
41. 250-hp, Frick Co., Waynesboro, Pa.
42. 50-hp, Westinghouse.
43. 375-hp, Lane & Bodley Co., Cincinnati.
44. Condenser, Worthington.
45. Condenser, Worthington.
46. 150-kw, Fort Wayne Electric Co., Fort Wayne, Ind.
47. 60-kw, Standard Electric Co., Chicago.
48. 120-kw, Westinghouse.
49. 120-kw, Westinghouse.
50. 5-hp Exciter, Westinghouse.
51. 5-hp Exciter, Westinghouse.
52. 30-hp Direct Current, Westinghouse.
53. 250-kw, General Electric Co., Schenectady, N. Y.
54. 1000-Light Alternator, Thomson-Houston Co., Lynn, Mass.
55. 100-hp Weston Engine Co., Painted Post, N. Y.
56. Pump Well.
57. Intake from Lake.
58. Delivery from Pumps.
59. Accumulator.
60. Condensers, Worthington.
61. Pumps, 21,000,000 gallons per day; Henry R. Worthington, New York.

extended description of all the exhibits shown, and only a few illustrations and short descriptions of two or three of the largest will be here attempted.

The General Electric Company.—The central space directly under the dome is occupied by the exhibit of this company. The space is surrounded by a neat, white cornice, supported 10 feet above the floor by white, iron columns, connected by a unique railing composed of railway specialties and cable. The cornice is lighted, inside and out, with colored miniature lamps and frosted 16-cp lamps. In the centre of the space is the office, surrounded by a magnified Edison

Government Building.

socket, 3 feet high, built out of 700 standard sockets. At each end of this space is a wooden pyramid with the sides forming display spaces, upon which are shown switches, fuse-blocks, cut-outs, and other supplies. Resting upon these pyramids and spanning the whole space is a model, made to the exact size of the upper field of a monocyclic generator installed in the Edison Illuminating Company's station at St. Louis, Mo. The armature of this machine is 16 feet in diameter, and of the field, 21 feet. As erected here, the armature would set on the floor and just fit into its field frame.

The company also exhibits a 30-hp three-phase induction motor operated from the monocyclic generator of the service plant. This motor runs a 20-kw four-pole generator, of 125 volts potential, at 675 revolutions. The current from this generator is used to light two illuminated signs, spelling the words "General Electric Company" in miniature lamps. The signs are suspended at each end of the exhibit and below the balconies, thus adding greatly to the illumination and appearance of the building.

There are also displayed modern incandescent arc lamps of fancy pattern, the kind known as "Thomson 93"; among them are some intended to be used on street railway lines, of 500 volts potential, being wired 10 in series, each having automatic cut-outs.

Alternating and direct-current arc lamps are also shown with complete equipment for the same. A small direct-connected engine and generator with switchboard is exhibited to illustrate the company's marine equipment. There is also exhibited a very comprehensive line of railway machinery made by this company, comprising a single-panel switchboard fully equipped with a new design of single-pole, quick-break, main switch, controlling safely the entire current from the generator, circuit-breaker, indicator, and other small devices, all properly and symmetrically arranged.

Street-car motors are also shown from the familiar G. E.-800 style to the G. E-2000 pattern, now competing with locomotives on elevated and suburban roads. A full line of controllers for street-car work, and of transformers for alternating incandescent work, are shown, the latter comprising sizes from 300 to 30,000 watts capacity. Samples of wire, cables, underground tubes, and street-junction boxes are fully illustrated. A number of fine photographs of different lines of machines not here displayed add to the interest and appearance of the exhibit, among which may be noticed one of the 96-ton electric locomotive now being used by the B. & O. Belt Line to haul its trains through its new tunnel at Baltimore. This machine has pulled a train of 44 loaded freight cars and three steam locomotives through the tunnel at a speed of 12 miles per hour.

Westinghouse Electric & Manufacturing Company.—This company has in Electricity Building, immediately in front of the south entrance, a large exhibit of electrical machines of various kinds. In the rear of the exhibit there is an office neatly fitted up, in the back of which stands a large panel having arranged upon it rows of incandescent electric lamps of various kinds, with different styles of globes. The most interesting feature of the exhibit is the two-phase motor for power purposes. In the rear of the exhibit there is one of

Transportation Building.

these driving an Augusta gin made by the Lombard Iron Works, of Augusta, Ga.; another driving a Gould air pump, and two driving the two cotton looms manufactured by the Whitin Co., of Whitinsville, Mass.

A very interesting part of the exhibit, and one that attracts considerable attention, is that of the street-car equipment with "12-A" motor, mounted on a Dupont truck, manufactured by the Johnson Steel Company of Johnstown, Pa. The truck has two motors of 30 hp each. The special feature of this motor is the ventilated winding on the armature. The winding had many advantages in the line of better ventilation and ease of repair, it being possible to remove any coil in case of accident and replace it by a new one without injury to the others.

The alternators in Machinery Hall furnish the current for driving the two-phase motors in the exhibit in Electricity Building.

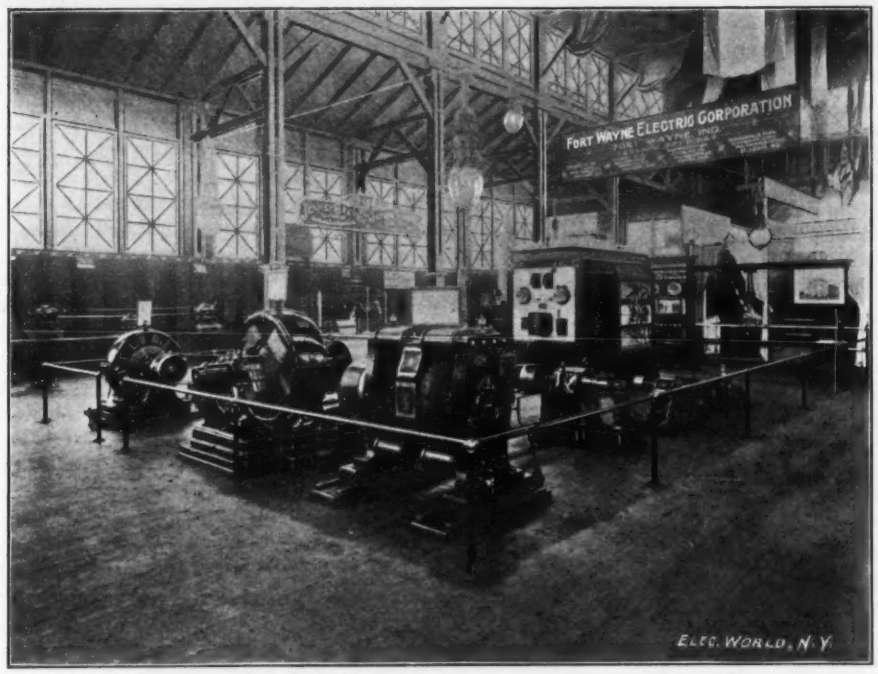
General Electric Exhibit.

This current passes through transformers which reduce it from 2200 volts to 220 volts, before passing through the motors. The principle of these motors is shown in an interesting manner in one part of the exhibit, where there is a coil corresponding with the magnetic coil on the motor. The coil here is covered with a wooden case, and in its

centre there is a depression in which metal eggs and other objects revolve exactly on the same principle as the armature of the motor. This two-phase system is the same now being used by the Niagara Falls Power Company, which will transmit power to Buffalo and neighboring cities.

Fort Wayne Electric Corporation.—The exhibit of the Fort Wayne Electric Corporation, which occupies a space of 20 x 40 feet, immediately north of the main entrance, contains a complete variety of the apparatus manufactured by that company, and is so arranged that any and all of the devices of this display can be operated whenever required.

The exhibit contains one 60-kw multipolar 110-volt generator ; an 80-light Wood arc dynamo ; one 50-kw compound Wood alternator ; one 160-hp 220-volt motor, and a Fort Wayne single-phase, alternating-current motor ; a variety of transformers from 6 to 750 lights, several sizes of 110 and 500-volt motors, together with switchboards, and instruments ordinarily used in their operation. At the rear of the exhibit is a lamp rack, on which are displayed all varieties of arc lamps



FORT WAYNE EXHIBIT.

manufactured by the Fort Wayne Company, and in the middle of this lamp rack is a board which contains four meters, together with a bank of lamps and necessary instruments to properly test the same. The alternator is driven by a 500-volt motor. The current after passing through the necessary transformers is used to light the top of the switchboards, which are arranged in the centre of the exhibits so as to form a large rectangular room. This current also drives the alternating current motor, which in turn drives a 110-volt generator, and a 110-volt current is used to run two incandescent lamps in series that are located on the lamp rack before referred to. The arc dynamo is also driven by a 500-volt motor, and the current is used to run the arc lamps which light the exhibit, and also those which are in position on the lamp rack. The exhibit contains several pieces of novel apparatus, which will be of particular interest to operators of electric light plants. The transformers exhibited here are claimed to be superior in point of efficiency and regulation. They are neat in design, and meet all the requirements of central stations. The alternator is so designed as to absolutely regulate through all degrees of load, and the proportions are claimed for the distribution of iron and copper, that short circuits, or any other abnormal changes of load which may occur on the outside circuits, do not injure the machine in any way.

The meters which are displayed upon the bank board are marvels of accuracy and simplicity of construction, registering equally well when running on light or heavy loads, the Duncan wattmeter especially being an instrument of very great sensitiveness ; in fact, so sensitive is this instrument that it will register exactly the current to bring a 16-cp lamp to a very dull red heat.

They also exhibit an arc lamp run upon an alternating circuit from a transformer so designed as to give an approximately constant current through the various voltages ; it is claimed that the windings of this transformer are so perfect that but little more current is consumed by the transformer when running on a short circuit, than when running on an open circuit. This unique winding of the transformer, together with the lamp, enables the common carbon to be used with great success, so that with the consumption of 9.6 amperes and 48 volts, a 2000-cp light is produced which burns with remarkable steadiness, and which is not easily put out by drafts of air.

Perhaps the most interesting of all the display of the Fort Wayne Corporation is the single-phase, self-starting alternating-current motor, which is run by a high-frequency current and started under a normal load. In starting, the motor is a series-wound multipolar motor and possesses the enormous starting torque characteristic of all series-wound motors. When it attains the necessary speed to synchronize with the generator, a small lamp on the top of the motor lights and indicates the fact to the operator who is starting the machine; he then throws the starting switch, which sends the current into the secondary winding, wound on the teeth of the armature that correspond with the poles of the field. The winding which was used to start the motor then becomes the winding of the generator, which excites the field. A small rheostat placed on the motor regulates the amount of field excitation, so as to obtain the best results under varying conditions of load and voltage. These motors are made in sizes up to 25 hp.

The switchboards here exhibited are one and two-circuits alternating-current switchboards, one 12-circuit arc switchboard, and a switchboard with instruments for a 110-volt generator.

The Southern Bell Telephone & Telegraph Company.—This company occupies the entire south-east corner of Electricity Building, and has a working exhibit of interest to all visitors, showing a complete central station in actual operation. The company furnishes 26 telephones, located at various convenient points throughout the building, 15 of which are for the use of the public, and the other 11 for the sole use of the Exposition Company. The central station in Electricity Building works direct with the central station in the city, and through it to any of its subscribers. The exhibit is also enriched and made more interesting by a large contribution furnished by the Bell Telephone Company, of New York, which is historical in its nature, illustrating the advance in the science of telephony, and showing by charts and models the various steps of its progress. There is also shown the company's submarine outfit and long-distance instrument, together with the peculiar apparatus belonging to each. The switchboard in use is of the latest pattern, and is quite as interesting, if not more so, than any other piece of apparatus shown in this exhibit.

The Telegraph in 1622.

A correspondent to the French journal *Cosmos* states that in a curious old work printed at Paris in 1622 there occurs a remarkabie passage, of which the following is a translation: "We may also tell you this great and wonderful secret, which a certain German has shown to King Henry, and who, by his industry and dexterity, is able to speak and converse with those who are far away, and this by means of the magnet. He first rubs together two needle magnets, and then places them each separately upon two clock dials, around which are engraved the 24 letters of the alphabet. If, then, they wish to speak together, or to make each other understand what they would desire, they move one needle around until it has pointed to the letters which are necessary to make the words and sentences that they would say, and as they turn one needle so also the distant needle turns, making always the same movement. The king, seeing this wonderful secret, forbade him to divulge it, fearing that thus would be opened very dangerous communications between the armies of his enemies and their besieged towns." The title page of the work in which the above passage is said to occur is as follows: "L'Incredu lite et mescreance du sortilege plainement convaincue par P. de l'Ancre, Conseillor du Roy en Son Conseil d'Estat a Paris. Chez Nicolas Bvon, Rue Sainct-Iacques, a l'Enseigne Sainct-Claude et de l'Homme Sauvage, MDCXXII."

Action of Current on Fishes.

According to a French journal the current from a Ruhmkorff coil between large metal plates in water will temporarily paralyze any fish which is between them, the fish rising to the surface upside down.

Polyphase Currents From Single Alternating Currents.

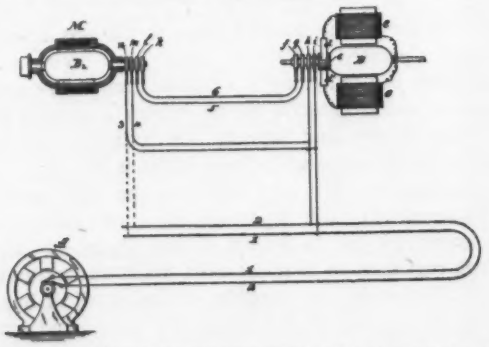
To the Editor of The Electrical World:

Sir:—On page 614 of the issue of Dec. 7, 1895, of your paper, is an editorial on polyphase currents from single-phase alternating currents. The tone of this editorial is decidedly against the use of phasing transformers. This impression seems to be derived from an article by Prof. Fessenden in the same issue. The Professor sums up that the losses due to current splitting will, according to his calculation, be 8.67 per cent. This, instead of being a bad showing, is very good indeed, and if a self-starting induction motor can be run from a single-phase circuit by so small a loss as 8.67 per cent., its uses are almost beyond calculation, on account of the great number of single-phase plants now in existence. It must be further borne in mind that the voltage is stepped down at the same time, and any practical engineer is well aware that the convenience and reliability of operation is of the first consideration, efficiency being second. I assume that Prof. Fessenden is referring in his paper to the phasing transformer described by me on Sept. 25, 1895, before the American Institute of Electrical Engineers. I may be mistaken in this, and if I am, I should esteem it a favor to be corrected.

According to Prof. Fessenden's paper, a large part of the storage of energy takes place in the iron, which is not the case in my phasing transformer, the principal part being stored in the condenser, and the efficiency of our condenser is much higher than those given by the Professor; but, even with the efficiency which he gives, we would feel that the editorial was entirely too severe, and that the conclusions are decidedly encouraging instead of discouraging. The editorial also speaks as though the cost, size and reliability of the condensers were a serious matter. I will admit that at the present time the cost is somewhat serious, but I am convinced that this will be greatly reduced. The size is very small, and reliability absolute when properly made.

Prof. Fessenden in the last paragraph of his article uses the following language: "It would therefore appear that a better method of making this conversion would be to devise a method in which the power is stored up in the momentum of the armature itself. Since, however, the armature has no momentum at the instant of starting, it must work differently while coming up to speed from what it does when running normally. I believe that it is not impossible to devise such a method." From this it would appear that Prof. Fessenden is not aware of all the work which has been done in the line he has suggested. I would refer him to my patent No. 409,449, Aug. 20, 1889, which describes a phase changer and a cut of this system as shown in Fig, 1, the description being as follows:

A represents the generator of alternating currents, and 1 2 are the distributing-mains extending therefrom in any desired direction. *B* represents the armature of what I term the "local-phase" changer, and in the figure the armature *B* is a simple drum-armature with rectifying-commutator *c*, on which bear the brushes *d d'*, and these are respectively connected to the terminals of the field magnets *e*. On the shaft of armature *B*, but insulated from the same and from each other, are four contact rings, *f g h i*, and of these the adjoining pairs *f g* and *h i* are respectively connected to diametrical points of



the commutator *c*, and therefore are connected into the armature-circuit—that is to say, rings *h i* are connected, respectively, to two opposite points, and rings *f g* are respectively connected to two other opposite points which stand at right angles to the former.

As described in my previous patent. No. 390,439, it is obvious that the alternating current taken from the mains 1 2 into the rings *h i* will pass into the armature *B*, and set the same in rotation, part of the current being rectified by the commutator *c*, so as to maintain a strong field. The current then passes out through the rings *f g*, and on the way has its time period or phase altered—that is to say, it has been retarded one fourth of a wave length.

At a point conveniently located in proximity to the described phase-changing apparatus I place the electric motor *M*, and its armature B^2 is similar to armature *B*, with the exception that it has no rectifying-commutator; but it is provided with rings *k l m n*, which are connected into the armature circuit of the armature B^2 in exactly the same manner as the rings *f g h i* are connected into the circuit of armature *B*, and obviously, if we can supply the motor-armature B^2 with two currents differing by a quarter-phase in their time-period, the motor will operate successfully and with facility. From the branch supplying current from the mains, 1 2 to the rings *h i* of the armature *B*, or from the mains 1 2 directly, I take the branch 3 4 and lead it to the rings *m n* of the armature B^2, so that the current supplied to the said ring *m n* is that circulating on the mains 1 2. From the contact-rings *f g*, I carry a pair of leads 5 6 to the rings *k l*, and as the current which has passed through armature *B* has had its phase retarded one quarter of a period, it is obvious that the motor-armature B^2 will be thereafter continuously supplied with two currents, one of which will be one fourth phase behind the other in time period.

Any number of such motors and phase-changing devices can be connected to the main circuit 1 2, and at the same time a portion of the current flowing through the mains can be used for electric lighting or any other desired purpose. I have shown the phase-changing device as substantially the same size as the motor, but this merely for the purpose of making clear its functions. In practice, however, since the armature *B* has no work to do except overcome its own friction and inertia and change the phase of the current, it may be very small, irrespective altogether of the size of the motor which it may be desired to use at any particular point, and therefore the phase-changing devices used throughout a system of distribution of this character may be all uniform, and being very small can be set to work in out-of-the-way places, where they will not be interfered with.

This was thoroughly reduced to practice and operates efficiently. It has the disadvantage of being a running device which needs care and attention from time to time. Undoubtedly there are many situations where this is preferable to any other device. I have tried induction motors for the same use, but the electromotive forces are not so perfectly maintained as in the synchronous device. The phasing transformer has the great advantage of requiring no attention.

Baltimore, Md. Charles S. Bradley.

Switchboard Illustrations.

To the Editor of The Electrical World:

Sir:—In your number of Dec. 7 there appears an interesting article on the electric lighting plant of the American Tract Society's Building, in this city. One of your illustrations (Fig. 3) is of the central switchboard panel. The supposition is that the reverse side would show work equally well done, and the writer desires to suggest that when next you illustrate the switchboard work of any of our large buildings, that you favor your readers with an illustration of the work upon the rear side of the switchboard. This suggestion comes from having recently had occasion to inspect several installations in various portions of the country, with the result that the wide variation in character and method was so marked as to emphatically demonstrate the necessity for making the reverse side of the board fully as useful, if not as ornamental, as the front side.

New York, N. Y. C. A. Benton.

Armature Windings and Connections.

To the Editor of The Electrical World:

Sir:—In the last issue of The Electrical World Mr. Harrison H. Wood states, in his article on armature winding, that "a four-pole machine cannot be wound with four conductors per slot," etc.

That statement as it stands is not true.

A large number of four-pole machines *are* wound with four conductors per slot, and without any dead coils or parts of dead coils.

A four-pole machine with 44 slots, and 88 commutator bars, or 88 slots and 176 commutator bars and a large number of others can be wound with four conductors per slot, using the "multiple drum winding," *i. e.*, wave winding. Owing to the importance of the article and the help the formulæ will be to electricians, I think the statement ought to be either modified or explained, Designer.

New York, N. Y.

To the Editor of The Electrical World:

Sir:—The statement that "a four-pole machine cannot be wound with four conductors per slot," etc., is not made without modification or explanation. The modification is found in the statement on the bottom of page 597, that lap windings are not further considered in the article, leaving it very plainly implied that all that follows applies only to *wave* winding.

The explanation is given in the remainder of the sentence of which the first half is quoted, where it is stated that "the value of y in this case is $S \pm \frac{1}{2}$, which is never integral." The writer did not show why y is not integral, nor how it follows that the winding is therefore not possible, because it appears so plainly from the formula for y that he thought there would be no one who could not see it for himself.

The whole difficulty with the writer of the above inquiry is that he has failed to understand the distinction between *lap* and *wave* windings, for he says that "a four-pole machine can be wound with four conductors per slot using the 'multiple drum winding,' *i. e.*, wave winding." Now a machine with 44 slots and 88 commutator bars,

or with any other number of bars, odd or even, can be wound by using "multiple drum winding," which is nothing more nor less than *lap* winding; but a four-pole machine, with no matter how many conductors per groove, cannot be given a wave winding with an even number of commutator bars, and when there are four conductors per groove, there will, to accommodate all the coils, have to be twice as many bars as grooves, and therefore an even number. Hence this case is impossible.

If this explanation does not satisfy the writer of the above, it would perhaps be well for him to submit a diagram of "multiple drum winding, *i. e.*, wave winding" showing how it may be used to accomplish the winding of four-pole machines with four conductors per slot.

HARRISON H. WOOD.

PITTSBURG, Pa.

The Invention of the Electromagnetic Telegraph.

To the Editor of The Electrical World:

SIR:—Since writing my contribution to the History of the Telegraph series, I have discovered other data which seem to have such a direct bearing on some of the questions at issue that I am sure you will permit me to write a few supplementary words.

In all of his letters to Morse, Alfred Vail makes a distinction between the invention and the proprietary rights. He constantly speaks of "your invention," but of "our interests." In none of his letters up to the last does he show the slightest traces of any ill-feeling toward Morse.

It is said that Vail invented the dot-and-dash alphabet, or rather adopted Morse's 1832 idea, for there can be no question of invention. In support of this claim there is only brought forward Baxter's statement and other hearsay evidence. In rebuttal I will quote Alfred Vail himself. He never in any of his writings that I have seen or heard of, hints of the justice of the claim that is made for him. Nay, more, this is what he himself has to say on the subject. In a letter to Morse, dated Washington, April 20, 1848, which treats of Bain's invention, he says explicitly: "To all this I have to say that he uses your system of marking, lines and dots, which you have patented." And further on: "Now I presume he could not use your mode of marking without violating your patent." Not "our" system, but "yours." Could anything be plainer than this? Morse, on the other hand, over and over again, speaks of "My conventional alphabet." I have not yet seen a direct claim on his part to the dry point. That he patented it as his invention, with the consent of Vail, has nothing to do with the case. Morse did not devise the plan of a zig-zag line on the *Sully*, but of a horizontal lever to mark dots and dashes. The constant reference on the part of Vail's advocates to the V-shaped marks is only an effort to befog the question. That Vail discarded Morse's crude apparatus and devised a new system unaided by Morse is amply disproved by Vail's letters at the time, as quoted in this series. He simply did that which he contracted to do, and he did it well. He was the right man at the right time. He took Morse's rough, but so far successful telegraph apparatus and, with Morse's assistance, made it more practical. This conjunction of inventor and skilled mechanician is of everyday occurrence, but the skill of the artificer does not invalidate the rights of the inventor.

The charges against Morse of bad faith, larceny, ingratitude, purchasing of honors and other dreadful misdemeanors ought perhaps to receive no notice from me. But they are so easily disproved that I am going to ask your indulgence for this purpose. The charges might have weight with some who did not know my father.

I have a letter from Dr. Laurence Smith to Benjamin Silliman, Jr., dated Constantinople, Aug. 17, 1847. Dr. Smith describes how he, unknown to Morse, showed the working of the telegraph to the Sultan, and he says: "In doing this I have done no more than my duty, and the result, so far as I can learn, will be a splendid decoration set in diamonds made expressly, and a diploma expressive of the Sultan's satisfaction to him [Morse]. As for myself, I do not think I will get anything but thanks. . . ." Perhaps it is not generally known that there are fees connected with the investiture of many foreign decorations, which accounts for the $100.

In the letter conveying to Morse the intelligence that certain governments of Europe had voted him a sum of 400,000 francs, this money is stated to be "*une récompense honoraire et toute personelle*," "an honorary and altogether personal recompense." It was not awarded to the patentees. It is true that F. O. J. Smith sued Morse for part of this money, and won his suit on a legal technicality. I have many letters which show that the opinion at the time was that although Smith won the suit, he had no moral right to claim any of the money. I can find no mention of any claims made by the other patentees.

Morse, after Vail's death, wrote to the Hon. Stephen Vail, not, as far as I find out, to the one of that name now living.

He asked for such letters "as could with propriety" be submitted to him, in order to defend the joint interest of himself and Vail's family. I find many copies of these letters so noted among my father's papers, but none of the originals.

The following is all the correspondence which I have found in regard to the instrument left to Morse by Alfred Vail in his will:

MORRISTOWN, N. J., Dec. 30, 1869.

PROF. S. F. B. MORSE.

DEAR SIR:—I have been authorized by the managing trustee (Mr. Theo. Little) of my father's (Alfred Vail) estate to address you in regard to the telegraphic instruments left to you by my father's will.

They are now in the house we occupy here, and we all feel that they are not where they should be, considering their value, at least to us; but as they were left to you by the terms of the will, we have no right to dispose of them without your authority. We do not feel willing to keep them here any longer, exposed as they are to the danger of being lost or destroyed; therefore I ask you what disposition to make of them.

The words of the will are: "I give and bequeath all my telegraphic apparatus in the cases in my hall, excepting the steel roller with three grooves, and brass lever with three points to fit in the grooves, to Prof. S. F. B. Morse, with a request that he will present them to the New Jersey Historical Society."

I am authorized that the New Jersey Historical Society would be very glad to receive them.

If you do not wish to take them away now, will you be pleased to send me, in writing, a relinquishment of all your rights in them as we do not wish to be responsible for their safety any longer?

I should be pleased to hear from you on the subject as soon as possible.

Yours with respect,

J. CUMMINGS VAIL.

This letter Morse answered the next day as follows:

NEW YORK, Dec. 31, 1869.

DEAR SIR:—In reply to yours of yesterday, I would say that it has been my intention for some time past to visit Morristown and your good mother, but I have been prevented as yet from the condition in which my late accident has left me. [He had broken his leg.] I am most of the time confined to the house, and I have ventured out in a carriage for a short drive only.

I should be most happy to visit Morristown again after so long an interval and renew old associations connected with your worthy father, grandparents and your Uncle George.

In regard to the telegraph apparatus so generously left me by your father. I should be glad *to have it sent to me*, seeing that I am unable to go to Morristown to inspect it and that it is rather in your way.

Will you have the goodness to have it all carefully packed in a box and sent to me by express? I will cheerfully pay the expenses, and after seeing the apparatus I can better determine the best mode of complying with the wishes of your father as expressed in his will.

Please give my respects to your mother, to your Uncle George and other old friends, with the compliments of the season, and accept for yourself my kind regards. Your obedient servant,

SAMUEL F. B. MORSE.

J. CUMMINGS VAIL, ESQ.

The next letter from Mr. J. C. Vail is dated Jan. 13, 1870, and informs Morse that the instruments have been shipped to him. To this letter Morse replies with one dated Jan. 24, 1870, and beginning "Excuse my negligence," etc., etc. Morse apologizes for a delay in answering of eleven days, not eleven years, as has been falsely intimated.

Mr. Morse is said to have declared to the widow of Alfred Vail on his death bed: "The one thing I want to do now is justice to Mr. Vail." In this same interview Morse said that the Hartford pamphlet made him sick. I have before referred to this pamphlet as a scurrilous attack evidently inspired, if not written, by F. O. J. Smith. In the margin Morse had characterized the claims made for Vail as "false." It is not conceivable that he could have said that his only wish was to do justice to Alfred Vail in the way in which his advocates would wish us to believe.

I have already said that one of the last letters Morse ever wrote was on this subject, promising that when he got well he would answer and refute that lie. This was the kind of justice he meant.

I have many letters to Morse from various members of the Vail family, written at different times, some only a short time before his death. They are all couched in terms of the greatest respect, and in none of them can I find any traces of bitterness. Under these circumstances it seems deplorable that such a strong feeling should now exist between the families of two such friends as Morse and Vail.

YONKERS, N. Y. EDWARD LIND MORSE.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Dynamo Testing.—"L' Ind. Elec.," Nov. 25, contains a short article by Mr. Girault in which he describes an indirect method for determining the efficiency, and other factors, of large continuous-current dynamos. It often happens that there is not sufficient power at the disposal of the manufacturer to test a large machine at full load; he describes a method in which it is easy to have at most the exact conditions of full load, and of smaller loads, without the consumption of so much power. The machine is first run at a speed much less than the normal, but so as to generate the normal current, the magnets being separately excited by the normal amount; the heating of the armature will then be the same as at full load; to obtain the same conditions as at full load, as regards excitation, armature reaction and shifting of brushes, it is only necessary to have the flux the same; the voltage at the terminals will then be equal to the E. M. F. at full load, multiplied by the ratio of the speeds, less that lost in the armature, which latter is equal to the resistance multiplied by the current; having determined this resistance by a previous test, it is then easy to calculate the E. M. F. from this relation; the same test can be made for different currents. This enables one to calculate the losses due to the resistance of the field and the armature; those due to hysteresis and Foucault currents depend chiefly on the resulting flux and the speed; if the dynamo is run at no load, as a motor, at the normal speed, and with the normal flux, the power absorbed, after making a reduction due to the electrical resistance, will give the sum of the mechanical losses and those due to hysteresis and Foucault currents. The only source of error is due to the uncertainty of the heating in the armature, in the test with a normal current but at slow speed; if the losses due to hysteresis and Foucault currents are then less, owing to the slower speed, the ventilation, on the other hand, will be less effective and the heating will generally be greater than that under normal conditions; furthermore, as the temperature varies very little beyond a certain limit, this could not be very important, especially as the conditions of the test are more disadvantageous to the dynamo than those under the normal conditions. In conclusion he urges the importance of having complete tests of the dynamos made by the constructor.

Coupling Compound Machines in Parallel.—The original of the article by Mr. Pigg, which was abstracted in the Digest, Nov. 9, is published in the "West. Elec.," Dec. 21, with but slight verbal changes; neither the reference nor the author's name is given.

Simple Analytical Theory of the Transformer.—The second article by Dr. Bedell, which was mentioned in the Digest, Dec. 7, is published in "Sibley Jour." for December.

LIGHTS AND LIGHTING.

Cost of Lighting by Gas and Electricity.—A report by Mr. Trotter, describing in some detail the results of tests and deductions from them, made for the municipal authorities at Hastings, is published in the Lond. "Elec." and "Elec. Rev.," Dec. 6. It is largely of local interest only; various lights, gas, incandescent gas, arc and incandescent electric lights were measured photometrically by means of a portable photometer, the consumption of gas and electricity being also noted; the Hefner lamp was used as a standard, and its value was taken as 0.877 standard candles; the arc-light tests were not very extended. He gives the following formula for finding the equivalent price of gas corresponding to any given price of electrical energy and incandescent lamps; let a be the price of a kw-hour in pence, b the price of 1000 cb. ft. of gas in pence, c the cost of lamp renewals per 1000 candle-hours, d the watt-hours per candle, and e the candles per cb. ft. of gas per hour; then the equivalent price of gas is

$$b = [(d \times a) + c]\, e\,;$$

some examples are worked out.

German Incandescent Lamps.—The "Elek. Zeit.," Dec. 5, reprints, apparently in full, the report of a commission representing the central lighting-stations in Germany, appointed to investigate the question of incandescent lamps. It is the same as was referred to in the Digest, Nov. 30. The conclusion is that the complaints of the consumers that the lamps are bad and worthless, is substantiated. Among the reasons are said to be poor sorting, incorrect marking, poor economy and poor life. In an editorial note an estimate is made showing that the difference between the supposed efficiency of 3.5 watts per candle and the real efficiency of 4.5, the loss of energy represented by the 500,000 lamps of 16 cp in the German stations represents nearly $800,000 yearly. It calls attention to the fact that much thought has been given to the efficiency of the machinery, while that of the lamps has received so little attention. The public does not appreciate what a good lamp means, and it is therefore to the interests of the manufacturers to make them as cheap as possible.

The Arc Light.—Prof. Thompson's third lecture (see Digest, last week) is begun in the Lond. "Elec. Rev.," Dec. 6. It is devoted entirely to the discussion of the mechanism of arc lamps, the first portion of it being historical, while the second is a detailed description of the Crompton-Crabb and Brockie-Pell lamps, which he seems to consider as the most important of English lamps. The lectures are also being reprinted in the Lond. "Elec. Eng."

Holophane Globes.—"L'Eclairage Elec.," Nov. 30, begins an article by Mr. Guilbert, in which he gives a detailed description with the theory of these globes, which are chiefly intended for arc lighting; they consist essentially of peculiarly shaped faucets which are horizontal on the outside and vertical on the inside, so proportioned that the light is diffused by total deflection and refraction with as small internal absorption as possible, the direction of the diffusion being such that the light is utilized to the best possible advantage; the diffusion is such that the curve giving the intensities of the light in different directions below the horizontal plane, approaches as closely as possible to the ideal curve (see Digest, Aug. 11, 1894), which gives an equal illumination on the horizontal surface below the lamp. Descriptions of these globes have been given and referred to in the Digest, Nov. 10, 1894, March 9 and May 11, 1895; see also Feb. 23; it appears from the article that these globes are now used very largely in France.

Illumination vs. Glare.—Mr. Scheible, in the "Elec. Eng.," Dec. 11, criticises the tendency which exists at present, to produce a very glaring light, citing the cases of show windows, dwellings and streets; glaring lights dazzle the eye and thereby produce a less effective illumination; he recommends large opalescent globes over incandescent lamps used in dwellings, and the placing of lights near the ceiling where they will be noticed less by the eyes; he considers it economical to cut off a third of the light by the tinted globe, as it not so much the candle-power which counts as the illuminating effect produced by it; on streets there is not a lack of light but a lack of its proper distribution; he thinks much more attention should be given to the use of street hood incandescent lamps, which he thinks would give a most desirable and effective illumination; there are many places in which a good deal of energy is squandered in order to produce an offensive glare, while the illumination could be much more agreeably produced by scattered light of lower candle-power.

POWER AND HEAT.

Electrically Operated Turrets.—Lond. "Engineering," Dec. 6, gives a well-illustrated description of the Canet electrically worked turrets, as constructed by a French company. The introduction of the Canet system has made great progress not only with the French navy, but with other governments also; at present this company is completing 40 such turrets.

Local Annealing of Armor Plates.—Mr. Anderson in the Lond. "Elec. Rev.," Dec. 6, in referring to the process recently described, in which the Thomson system was used, states that during the last two years he erected four plants for doing precisely the same work by a modified Bernardo process, and they are working in a most satisfactory manner.

Electric Furnaces.—A large furnace, devised by Mr. Urbanitzky for the reduction of iron ores, is described and illustrated in the "Zeit. f. Electrochem.," Nov. 20. He points out the advantages of an electric furnace, particularly for the reduction of very pure iron, stating that the difficulties heretofore consisted in constructing furnaces which enabled the action to be continuous and on a large scale. The large carbons enter the furnace from the top and are supported from a disc capable of being revolved around a vertical axis. In such a furnace 500 hp are said to produce about 10 "metrecentner" (apparently meaning 100 kg, that is, 220 pounds) of pure iron per 24 hours of operation, requiring only one man. The cost of operation is given in some detail, the total being about $6.25 per 100 kg of fine steel, the power being obtained from steam. This includes the necessary rolling machinery for working the steel as well as all other expenses. He states that according to Siemens, theoretically a pound of coal, with the aid of a steam engine and dynamo, will melt a pound of steel.

Direct vs. Alternating Currents for Long-Distance Transmission.—Mr. Baxter's article (See Digest, Dec 14) is continued in the "Elec.

Eng.," Dec. 11. He continues his argument to show that the direct current is better than the alternating. Regarding the practical adaptability, he states that the former would be most desirable, even if the alternating were just as well suited for commercial requirements, which is not the case. The only extensive application at present is for incandescent lighting. For arc lighting it is far inferior and it is used for this purpose only when the lamps are far apart and few in number. For motor purposes he states that the alternating current at present "is of no practical value," (presumably he does not intend to include the numerous successful installations in which power is transmitted from one generator to one motor); he argues that there must be some practical obstacle in the way of the rotary field motor, as it was about eight years ago that the first machines were made, and at the present time they are only used in a few isolated cases; it is entirely excluded from the railway field, or any other purposes where a variable speed is necessary. As the greatest development in the electrical industry at present is "along lines in which the alternating current is not adapted, it seems folly to discard direct currents, as we have done, without any effort to determine its possibilities;" one of the principal objections to the alternating current is the increased difficulty of transmission; he thinks it a wiser policy to rectify the current before transmission, and thereby obtain better results. For equal E. M. Fs. the line construction is cheaper for the direct current; the cost of alternators and continuous-current generators is so nearly alike that they may be considered equal for a rough comparison; the cost of direct-current transformers is less than that of the alternating; he concludes that the cost of installation of the alternating system will be the greater; also that if his deductions are correct, the direct current can be superior to the alternating under the conditions of an equal number of transformers, when it can be used with a higher E. M. F., which latter he thinks can be done.

Light and Power from Garbage Crematories.—Mr. Barnett, in the "Elec. Eng.," Dec. 11, calls attention to the systems of refuse destructors used abroad, saying, on the authority of Mr. Jones, that from the 50 destructors mentioned by him in a recent book, there is obtained an average of 5 to 7 hp per cell, consuming daily from 3.5 to 10 tons of garbage. He refers to the suggestions of Mr. Gibbings to use accumulators for storage purposes, and to the plant at Shoreditch, where the Halpin thermal storage system is used, both of which were noticed in these columns. At present there are over one hundred destructors in England, which are furnishing power in industrial establishments at considerably less cost than if it were obtained from coal, while in this country there is not a single installation of the kind, which he believes is partly due to the use of anthracite coal, but believes there is quite a large area where the conditions are as favorable as they are in England; he suggests that the matter should be given attention, and recommends the use of storage batteries as the best means of starting, on both theoretical and practical grounds; they are cheaper in first cost than an equivalent steam-power plant, which they would replace; they have a wider range of power, and are more economical in operation than any other form of storage; he suggests that municipalities should seriously consider the question of combining their lighting stations with some well-equipped garbage crematory combined with storage batteries.

Welding.—Some of the illustrations of the Zerener apparatus, from the article abstracted in the Digest last week, are reprinted in the "Elec. Rev.," Dec. 18.

TRACTION.

Gas-Driven Railway Cars.—The Lond. "Elec.," Dec. 6, states that the gas railway cars at Dessau have been running successfully for a whole year; the line is nearly four miles long, and includes 9 cars of 7 hp, 4 of 10 hp and 4 trailers; the amount of gas consumed on the cars averaged 26.6 cb. ft. per car-mile, to which should be added 4.46 cb. ft. which are used in the engines driving the compressors, making a total of 31.06. It is added that if what has been done at Dessau can also be done elsewhere "the battle between gas and electric cars would evidently have to be fought on other issues than the cost of fuel."

Submarine Boat "Goubet."—"L'Energie Elec.," Dec. 1, contains an illustrated description of this submarine boat, which has just been completed, and with which experiments were made in Paris; a brief description is given in the Lond. "Elec. Eng.," Dec. 6. It is shaped somewhat like a cigar, but is pointed equally at both ends; it is 26 feet long, about 12 feet in width, and is made of gun metal; access to it is made by means of a manhole at the top, and which can be hermetically sealed; the weight is 10 tons, and it is calculated to resist the water pressure at a depth of 160 fathoms; there is room in it for one officer and one or two sailors; the air is stored in steel cylinders, under pressure, and the vitiated air is exhausted by means of pumps; to make it sink water is admitted to chambers provided for that purpose. The motor power is a battery of 56 cells of accumulators, weighing about 1 ton, and giving 20 amperes at 90 volts for 14 hours; the propeller makes 250 revolutions, and the steering is done by altering the direction of the screw; in case of accident a weight carried at the bottom can be detached, and the boat then immediately rises to the surface.

Recording the Movement of Cars.—A chronograph recorder, which appears to have been used successfully for two years at Terre Haute, is briefly described in the "Elec. Jour.," Dec. 15; it shows at the station whether the cars are running regularly or not, and if there is a stoppage, it indicates where it is, and how long it lasts, how many cars are blocked, etc. It consists of a band of paper moving at a uniform rate, under a series of pens or points operated by magnets, each of which represents a point on the road, and acts whenever a car passes this point, making a mark on the paper; the paper moves at the rate of four inches in an hour; no illustration is given.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Danger from 220 Volts.—Mr. Isherwood in the Lond. "Elec. Rev.," Dec. 6, gives his experience with an installation in which 220 volts were used; he shows that either double pole cut-outs with a very high fence, or two single pole cut-outs, would be necessary to render arcing impossible; wall-plug and lamp holder contacts should also have a fence to do away with any risk from short ends of the flexible cords; the lamps have also given much trouble, the filaments showing a tendency to get entangled or the two turns of the spiral to get caught in the platinum hook supposed to keep them apart; one of the lamps was fired from its cap like a rocket when the current was turned on.

Shrewsbury.—A long, illustrated description of this plant which was recently opened, is published in the Lond. "Elec. Eng.," Dec. 6, and a brief one in the Lond. "Elec. Rev." It is a small plant but is said to be in some respects a model small station. A feature of interest is said to be the balancing transformer which is capable of dealing with 160 amperes passing in the middle wires of the 3-wire net-work of the low-pressure continuous-current system; the machine has a single set of magnets and the armature has two equal windings with a commutator at each end: it seems that there are two of these; the secondaries have an output of 50 amperes at 35 volts; these are connected in series with the mains for charging the accumulators.

Railroad Station at Munich.—A long, well-illustrated description of the plant at the Central Railroad station in Munich is published in the "Elek. Zeit.," Dec. 5. Arc lamps are run with continuous currents, at most, six in series, while for the internal illumination the alternating current is used for both arcs and incandescents; the plant was installed by Siemens & Halske; each engine drives by means of one belt either an alternating or a continuous-current dynamo, both of which are on the same foundation with their shafts in line, and either of which may be connected with the common pulley, or if the belt is taken off the alternator can be used as a motor to drive the continuous-current dynamo.

Cassel.—The annual report of this station is abstracted in the "Elek. Zeit.," Dec. 5; the output and expenses are given in detail; one of the figures of general interest is the efficiency of the accumulators for the whole year, which in ampere-hours was 85.3 and in watt-hours 72.5.

Load Lines.—Some curves of the Cambridge Company are given in the Lond. "Elec.," Dec. 6.

Prize Offered for a Fuse Design.—The conditions of the prize mentioned in the Digest, Oct. 5, offered in Germany, are given in the "Elec. Eng.," Dec. 11.

WIRES, WIRING AND CONDUITS.

Underwriters' Rules.—In the "Elec. Eng.," Dec. 11, Mr. Dobbs suggests some changes. The rule requiring a certain thickness of insulation around the wires, he thinks, should also require two asphaltum soaked braids in addition to the rubber. The one referring to concealed work seems unnecessarily restrictive, since the insulation of the wire is not to be depended upon. Then why require a high grade of insulation, as a cheaper grade of wire would answer? Or if the highly insulated wire is required, then why not do away with the porcelain knobs and bushings? He favors conduit work, which he thinks will be just as safe as any other, if the inspector takes proper care; it is not so much the methods of running the wire as the outlets, that need looking after; the wires carrying over 10 amperes should be soldered to copper or brass terminals when brought into a switch or cut-out. Cleats which break the insulation of the wire should be forbidden; he sees no force in the objection to strings placed in the conduits as they are put up. The question whether outside wires may not be brought closer together than 12 inches, should be considered. He does not think there should be a cover on the cut-out itself, but if so it should be at least two inches away from the terminals, as the arc is much worse in a covered fuse block than in an open one, as the air is driven out, leaving a partial vacuum, which maintains the arc for a longer time. He hopes that the Edison socket with the tongue contact will be condemned, as also the Edison 10-ampere snap switch. He does not see why the New York inspectors require asbestos in back of the switches and cut-outs, as he never heard of a case of a cut-out arcing at the back. He hopes the committee will provide some method of securing a uniform interpretation of the rules.

ELECTRO-PHYSICS AND MAGNETISM.

Variation of Conductivity of Wires in Different Dielectrics.—The Lond. "Elec.," Dec. 6, comments briefly on the recent article by Mr. Sandford, which was abstracted in the Digest, Nov. 30. It claims that the notion that the resistance of a conductor depends on its dielectric environments has no more to do with the truth or otherwise of Ohm's law than tinning the surface of copper wires has to do with the same principle of current flow. No judgment is passed on the experiments, but it is claimed that they are

by no means convincing either way. It is thought, however, that there is enough in them to justify further investigation of the matter. It seems certain that if there is any effect it must be a skin effect. It suggests that conductors of equal section but different surfaces should be experimented with.

Condenser Oscillations.—An article by Mr. Toepler from the "Wied. Beiblatter," No. 10, is noticed briefly in the Lond. "Elec.," Dec. 6; he endeavored to supply all the links connecting condenser oscillations with Tesla's experiments. The oscillations were transformed to lower and to higher pressures respectively; in the former case several new phenomena were observed which had not as yet been produced with electrostatic apparatus; in transforming up, all of Tesla's experiments could be reproduced; iron cores diminished the induction of these high-frequency currents.

The Laws of Induction.—A paper by Mr. Ebert from the "Zeit. f. Phys. Chem.," 18, page 321, is abstracted in "L'Eclairage Elec.," Nov. 30. He deduces the laws based on energy as a fundamental quantity and gives the dimensions for a number of electrical and mechanical quantities on the basis of the fundamental units, length of time and energy, as suggested by Ostwald; for the arbitrary unit he takes the current which passes through a circular conductor of a radius of 1 cm and possesses an amount of electromagnetic energy equal to one megaerd; in the dimensions it seems that he uses both energy and current besides time and length, although the latter enters only into the dimension of mechanical force.

New Charts of the Earth's Magnetism.—An Academy paper by Mr. de Bernardieres is reprinted in "L'Eclairage Elec.," Nov. 30, and "L'Ind. Elec.," Nov. 25; it refers to the work of the French Bureau of Longitudes.

Action of Two Currents on Each Other.—Dr. Kalischer in the "Elek. Zeit.," Dec. 5, states that there is an error in the appendix on the fundamental laws of electromagnetism in Thompson's book on the Electro-Magnet. Ampere's formula is there given for the action of two current elements on each other, with the condition that the current is measured in amperes; this formula would be correct if the current were supposed to be expressed in the absolute electromagnetic system; the system of units in the Ampere formula is the obsolete electrodynamic system; the unit in the former is to the unit in the latter as the square root of two is to one; Ampere's formula must therefore be multiplied by two if the currents are to be expressed in the electromagnetic system. The other formulas on the same page of that book, he says, must be corrected in the same way.

Conductivity of Hot Gases.—The article by Mr. Pringsheim abstracted in the Digest, Oct. 19, is abstracted in "L'Ind. Elec.," Nov. 25.

Thermo-Electric Generator.—The article which was abstracted in the Digest, Sept. 21, giving the suggestions of Mr. Meyer, is abstracted in the "Elec. Eng.," Dec. 11.

Holtz Machine.—An easily understood description of the machine and its action, are given by Mr. Thornton in an article in the "Elec. Jour.," Dec. 15.

ELECTRO-CHEMISTRY AND BATTERIES.

Chlorine and Soda.—A recent paper by Mr. Hargreaves, describing his process and criticising those of others, is abstracted and discussed editorially in the Lond. "Elec.," Dec. 6. It seems to contain little that is not already well-known. He alleges that the mercury used in the Castner-Kellner process is a cause of danger to the workmen, but in the discussion it was shown that at Oldbury, where the process has been worked 2.5 years, there was no mercurial poisoning whatever among the workmen; the loss of mercury was well under 2 per cent. per annum, half of which was recovered from the sweepings. Mr. Swinburn made the practical statement that after all the difference in efficiency in various processes was not necessarily the largest item in deciding the cost; Mr. Blount called attention to the small output per unit of plant in all electrolytic processes; the item of depreciation is often a serious one and perhaps a lower economy might be overbalanced by a decrease in first cost and cost of maintenance. A warning is given against the acceptance of Hargreaves' figures for the voltage required, as the low figure given by him, namely, 3.4 volts, applies to sodium carbonate and not to caustic soda.

Formation of Cuprite.—A paper by Mr. Majorana from the "Wied. Beiblatter," No. 10, is noticed briefly in the Lond. "Elec.," Dec. 6. He investigated the formation of cuprite, Cu_2O by the electrolysis of copper sulphate. When a small current is passed through dilute $CuSO_4$ acidulated with sulphuric acid, ruby-red crystals of cuprite are formed, especially when the solution is heated.

Accumulator Tests.—A short table of results of tests made in behalf of the State Railway of Baden, is given briefly in the Lond. "Elec.," Dec. 6. Three kinds of cells were tested, their normal discharge-rate being 1000 amperes, and their guaranteed capacity 3000 ampere-hours, The cells were the "Hagen" (known here as the Tudor), the Kalk (sometimes known as the Hagen) and the Gelnhausen (better known as the lead dust accumulators). The results of a number of discharges are given, for an excessive, a normal, and several slow discharges, the excessive reaching as high as 5280 amperes. In each one of these, with one insignificant exception, the Gelnhausen gave very much better results than the others, and the Tudor cells came next, although they were in some respect inferior to the Kalk.

Action of Metals in the Electric Furnace.—An Academy note by Mr. Moissan is noticed briefly in "L'Ind. Elec.," Nov. 25. He believes that compounds of silicum may be produced in the electric furnace like the carbides; little is known of these silicides. The action of silicum on metals can give three different results: The solid can combine with a solid metal, and give by an action similar to cementation, a true silicide; the liquid silicum can unite with the molten metal in the electric furnace; the silicum can dissolve in the metal, and does not form a combination with it in becoming crystalline when the metal solidifies.

Blot Accumulator.—An illustrated description of some length is given by Mr. Margaine in "L'Ind. Elec.," Nov. 25. He calls attention to the poor contact between the supports and the active material when the latter is put on mechanically, as in the Faure type of cell, and states that this contact becomes worse and worse; with this type of accumulator the layer of active material is always too thick in proportion to the surface of the electrodes, and the result is that the active material can be utilized only to a portion of its depth; according to Faure a depth of only 0.5 mm is utilized in a total depth of 5 mm; Margaine thinks even this is greater than what is obtained in practice (but this evidently depends on the porosity); 0.9 of the weight is therefore merely dead weight; the fault of this type of accumulator therefore is that there is not sufficient adherence between the active material and its support to assure a good, permanent conductivity, and the proportion between the amount of oxide and the surface is not the proper amount; such accumulators, furthermore, are of short life and have a maximum capacity at the beginning. To avoid all this the present accumulator is made of the Planté type; the active material, when formed electrolytically, adheres very strongly to the lead support on which it is formed, and it is therefore possible in this to use very high rates of charge and discharge; he considers the Planté form as the only rational one; in this there is less danger of buckling than in the others; the capacity is said to be equal to the best of the other accumulators, and is claimed to vary very little with different rates of charge and discharge. The plates are constructed of a large number of vertical bands of lead, alternately flat and corrugated, the planes of which are perpendicular to that of the plate; the lower ends are all soldered together to the frame, while at the upper end these bands pass over a portion of the frame; the lead is 0.5 mm thick; the surface of such a plate is said to be one third of a square meter per kg of plate; it is stated that the plates may be discharged at any rate, even as great as a short circuit, without the least buckling; these plates are suspended on a somewhat complicated frame in which they rest on glass; nowhere do they touch the bottom of the cell. The capacity is said to have always exceeded 10 ampere-hours per kg (4.5 per lb.) at the normal rate of discharge, one ampere per kg; some of them have reached as high as 19 ampere-hours per kg (8.6 lb.). The tests made at the Central Laboratory with a 4-plate cell weighing 1.515 kg, are given briefly; the rate of discharge per kg of plates was 0.86 to 1.33 and the capacity in ampere hours per kg of plates was 19.0 and 15.8 respectively. The cell was discharged by the author at a rate of 0.5 to 5 amperes per kg of plates, and it was overcharged to 3 and 4 times its capacity, both of which produced no bad effect. About a year ago a battery was installed weighing 7.5 kg. per cell, and was daily used for soldering, at the rate of 80 to 200 amperes; after 5.5 months there was not the slightest bending of the plates; another battery of 44 cells was installed near Glasgow, the total weight of which was 20 kgs, and which was charged at 40 to 80 amperes, which is equal to 2 to 4 amperes per kg of plate. To determine the life of the plates a calculation is made to see how many times the layer of active material may be formed over again before it has completely consumed the lead, and the number is found to be 15.

The Middle Conductor in Electrolysis.—The "Zeit. f. Electrochem.," Nov. 20, contains an article by Drs. Loeb and Kauffmann in which they discuss at some length the principle of an electrode placed in an electrolyte, between the anode and the cathode, and which they call the middle conductor. They state that the discovery of the action of such an electrode dates back ninety-three years, when it was discovered by Prof. Ermann, and they express surprise that it is being re-discovered repeatedly, referring in particular to the recent description of Mr. Andreoli's process which he calls "Indirect Electrolysis" (see Digest, Aug 23, and Sept. 14). In the present article they describe a number of experiments with such a middle conductor. They used eight volts and placed an electrode in the middle of the tank between the others, connecting it, when desired, to different parts of a resistance placed between the terminals, and therefore shunting the bath, the whole forming a sort of Wheatstone bridge. When copper sulphate was used and the middle conductor, of platinum, not connected to the circuit, copper was deposited in the form of a circular patch on one side of the electrode, while on the other side corresponding to this patch, oxygen was evolved; a curious feature was that the line of demarcation of this circle was very sharp, even under the microscope; the theory is discussed. A number of other experiments were described, and among other things it was shown that the voltage at the terminals was always the sum of the separate voltages between the intermediate and each of the extreme electrodes. (The features which Mr. Andreoli claimed to be new do not appear to be discussed.)

Electrolysis Without Diaphragms.—Dr. Bein, in the "Zeit. f. Electrochem.," Nov. 20, describes a method, which was recently patented in England, in which the mixing of the products of electrolysis is prevented

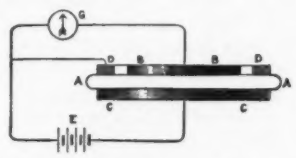
without the use of a diaphragm; in general the vessel appears to be divided into four compartments by three partitions, the middle one of which reaches nearly, but not quite to the top of the liquid, and the two others, extending through the top down into the liquid, to nearly the bottom; the products of electrolysis are prevented from mixing by the middle partition, and may be drawn off, if liquids, at the bottoms of the two outside partitions. In the specific application to chlorine and soda, only a single partition is used, which extends from the top nearly to the bottom, the two electrodes being in the two compartments thus formed.

Zinc Plating.—The Heathfield process is described and the apparatus illustrated in the "Zeit. f. Electrochem.," Nov. 20. The articles are first plated electrolytically with a thin coating of mercury, on which the zinc is then deposited. If it is intended to be very bright, another thin coating of mercury is deposited over the zinc. If the mercury does not amalgamate with the metal, then the zinc amalgam is said to be used as a foundation for the coating of zinc. This is not explained clearly.

Galvanic Etching.—A process for etching letters, names or designs on metallic goods, such as knives, for instance, is described in the "Zeit. f. Electrochem.," Nov. 20. The objects are covered with the following mixture: One liter of naphtha, ½ kg of carbon bisulphide, 2 kgs of pulverized resin, and 1.5 kg of chloride of copper. After covering with a thin layer of this the stencil or type is washed with a weak solution of potash and pressed on the surface, which is then washed, after which it is wet with a weak solution of sal-ammoniac through which a current is passed, which then etches the metal where the insulating coat has been removed.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Avoiding Surface Leakage in Insulation Tests.—Mr. Price in the Lond. "Elec. Rev.," Dec. 6, described a very simple and ingenious method for avoiding the errors caused by surface leakage in testing dielectric resistance by the direct deflection method. The current measured in the galvanometer is generally assumed to pass through the dielectric in the ordinary method, but if a portion leaks over the surface it introduces an error in the result, making the specific resistance appear too low; to overcome this, in the case in which a slab of insulating material is tested between two discs, he uses the method shown in the accompanying figure.



AA is the slab of insulating material, *BB* and *CC* the contact discs; the former is made smaller and is surrounded by a metal ring, *DD*, which is connected as shown, supplying the leakage current, which, as it will be seen, does not pass through the galvanometer; it is assumed that the resistance of the conducting film, between *B* and *D*, is large as compared with that of the galvanometer, in which case no current will flow from one to the other. He also shows that the same principle may be applied to cable testing; the ends are trimmed as usual, and a small coil of thin, bare copper wire is wound closely, two or three times, around the middle of the exposed ends of the insulation, and these are connected together and to the circuit, like the ring *D* in the above figure; these coils should be wound on both ends of the cable.

Potentiometer.—The article by Mr. Fisher (see Digest, last week) is continued in the Lond. "Elec.," Dec. 6. It is devoted to a detailed description of the Crompton instrument and is accompanied by a good illustration of it; the description does not admit of being abstracted. Beside the portion of the slide wire scale there is another scale showing the exact point indicated in degrees C where the contact should be placed when adjusting by means of the Clark cell, for different temperatures of that cell, an ingenious device which saves much time and calculation; the writer (who seems to have had considerable to do with the designing of this instrument) also tried the circular type, but abandoned it for several reasons. Any alteration of the temperature affects the whole instrument equally, so that the possible error from this cause is very slight; up to recently, since the rejection of platinum alloys, maganin was used, but owing to the difficulty of getting two samples alike nickel-steel alloy was adopted and has given every satisfaction, one of its valuable attributes being that it remains untarnished for any length of time, especially with a slight film of oil on its surface; this is true even in rooms containing sulphuric acid fumes from accumulators. One of the important features of the instrument is the contact arrangement for the sliding wire; this is so arranged that the contact is made by a spring which is released by the key and therefore the pressure, which is governed by this spring, is always constant and cannot be increased by undue pressure on the key; this device is illustrated in detail.

Measuring the Potential of a Metal in a Liquid.—In a paper by Mr. Reiner in the "Wied. Beiblatter," No. 10, noticed briefly in the Lond. "Elec.," Dec. 6, he describes a new method of measuring the potential of a metal immersed in a liquid. The liquid is put to earth by a wet thread, and the metal connected with an electrometer. Copper in copper sulphate is positive. (It would be interesting to know how the instrument was grounded, and whether there is any difference when it is grounded through the iron gas pipes, the lead water pipes, or carbon earth plates.)

Direct Reading Platinum Thermometer.—A Physical Society paper by Mr. Appleyard is noticed briefly in the Lond. "Elec.," Dec. 6. It was devised for determining the temperature of dielectrics in experiments to measure their variation of resistance with temperature; the thermometers consisted of six platinum coils of about seven ohms resistance each; a slide wire bridge is used to measure the resistance; the slide wire is three meters long; the auxiliary coils are contained in paraffine oil, the temperature of which is kept constant by means of an incandescent lamp immersed in the oil.

Electrical Laboratories.—A brief description by Mr. Pierron of eight different electrical laboratories of societies and institutes in France, Germany and Austria is begun in "L'Elec.," Dec. 7.

Hot Wire Mirror Galvanometer.—Mr. Szapiro, in the "Elek. Zeit.," Dec. 5, referring to the recent description of an instrument by Mr. Friese (see Digest, Dec. 7), states that the fundamental formula which is given is not correct, as it was assumed that the increase in length of a wire through which a current passes is proportional to the amount of heat generated in the wire, while as a fact it is proportional to the increase of temperature, which is not proportional to the square of the current on account of convection, radiation and conduction of heat.

Photometry.—In his serial in the "Elec. Jour.," Dec. 15, Prof. Thomas gives briefly the arrangement of a photometer room. The arrangement depends on the class of work to be done; for incandescent lights, he recommends a Dibdin-Pentane or a Harcourt No. 2, as a standard; a bar about 2.5 meters long, a Lumner-Brodlun sighting box, or a sighting box containing a Leeson star disc, or a Bunsen disc, in the order of their preference; an ammeter, a voltmeter, a storage battery and resistance for adjusting the voltage of the lamps; as a sperm candle is the only legal standard it should be provided. The room should be large and free from vibrations and from air currents; the standard should be placed in a box with proper openings for ventilation and for light; the person making the readings, should keep his eyes in total darkness for a minute or more, and should avoid looking at the lights, as a glance at them will unfit him for good work for some minutes; the scale may be read with the aid of a small pea lamp; he recommends adjusting the voltage by means of a slide wire, in order to obtain greater accuracy.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephony in Berlin.—The "Elek. Zeit.," Dec. 5, contains a long article by Mr. Landreth, on the past and future development of telephony in Berlin.

Multiplex Telephony.—Mr. Miller, in the "Sibley Jour." for December gives a brief summary of what has been done in this direction in the form of brief extracts of two patents. The first is to Mr. Jacques. The system is based on the principle of the persistency of hearing, which is analogous to the persistency of vision. The ear can detect sounds lasting only a very small part of a second, but it will fail to notice an interruption of much longer duration in an otherwise continuous sound. A diagram of the system is given; the apparatus consists essentially of two reeds which are made to vibrate in unison by means of an alternating current passed through the magnets causing the vibrations. One of these reeds is at each end of the line. In the extreme positions of this vibrating reed it makes contact with each of the two telephone circuits, or, in other words, the two reeds simultaneously connect the line alternately to one and then to the other set of telephones. The vibration is so rapid that the circuits are not opened for a period greater than 0.01 of a second. By having the reeds making contact successively with a greater number of plates, a correspondingly greater number of conversations may be carried on; (nothing is said about the second wire which carries the alternating current for vibrating the reeds and synchronizing their movements; if two wires are required, why not use two distinct telephone circuits and avoid the complications? The second system is that devised by Messrs. Hutin and Leblanc; it is based on a system of resonators, each consisting of a combination of a condenser and a self-induction; sounds composing speech may be resolved into a number of components, each of a simple musical tone, and when these are all re-combined the original sound may be reproduced; instead of re-combining all of them, only a part may be selected, and the resulting sound will then not be exactly the same as the original, but will differ only slightly from it. At each end of the single line there were three groups of resonators, each group, connected to a telephone, is tuned to definite frequencies which are exactly like those of the corresponding group at the other end; the frequencies of the different groups at the same end are not made commensurate with each other, so that each group responds to only those frequencies which were generated in the corresponding group at the other end, while it will prevent the passage of any current of a different frequency; thus 10 components of the current will be transmitted and will be re-combined at the receiver. As far as the writer is aware, multiplex telephony has not been practically or commercially successful, the difficulties of the problem being much greater than those in multiplex telegraphy.

Calculagraph.—An instrument by this name is described and illustrated in the "Elec. Eng.," Dec. 11, and "West. Elec.," Dec. 21; it is intended for recording the time between the signal of the calling subscriber, the beginning of the conversation, etc., and is used on the long-distance system in New York.

MISCELLANEOUS.

Treatment in Case of Accident.—The official document of the Minister of Public Works in France is translated in the Lond. "Elec. Rev.," Dec. 6.

Electricity at the National Capitol.—The "Elec. Rev.," Dec. 18, contains a short article by Mr. Deayer describing briefly the new electrical appliances which are to be introduced at the Capitol. There will be a direct-current plant for lighting, consisting of two direct-connected 75-kw, 125-volt generators with a total capacity of 6000 lamps of 16 cp. There will be a set of powerful signal lights on the summit of the great dome; heretofore a night session of either house was indicated by a lamp on the dome; there will now be a blue light to indicate that the Senate is in session and a red light to show that the night session is in the House. Welsbach burners were tried in the Senate Chamber, but they were not a success, and it is now contemplated using the so-called incandescent arc lamp. Another feature is the introduction of annunciators connecting each member's desk with the call-board in the cloak room, for calling pages, in order to dispense with the very objectionable custom of clapping the hands. A plan has also been proposed to facilitate voting and to eliminate the long and tedious roll call; the plan contemplates running wires from each member's desk to a large indicator at the Speaker's table, and the vote may then be taken in a few seconds, whereas it now takes 30 to 45 minutes. A special telephone service connecting the House and the Senate will also be introduced; heretofore the only telephonic communication between the two was through the exchange. There will also be a chronometer connected electrically with the National Observatory.

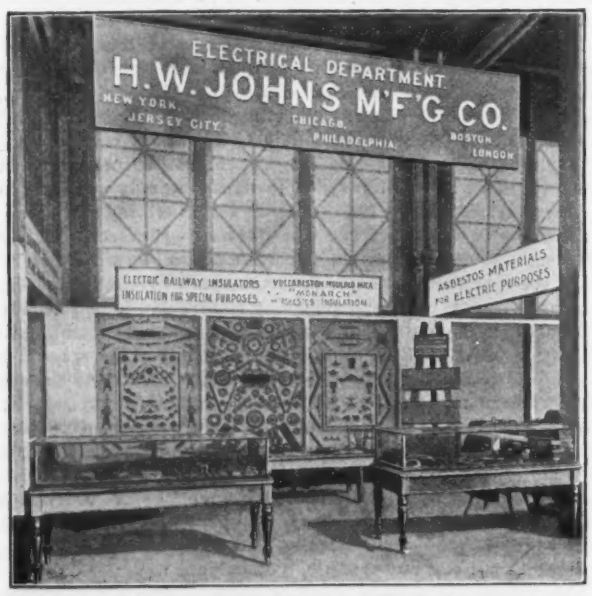
Electric Rifle.—The Blake rifle is illustrated and described in the "Elec. Eng.," Dec. 11; a battery is contained in the stock; the trigger closes a circuit through the cartridge, thus firing it; two wires enter the cartridge and their ends "nearly meet"; it seems that the current is intended to jump over the space, establishing "an arc" in the cartridge; by having the point of firing near the bullet end of the cartridge a more effective explosion of the powder is said to be secured; (what the other advantages are claimed to be is not stated, nor is it shown how such a small battery can strike an arc between two wires not in contact.)

Biographical.—A full-page portrait of John Frederick Daniell is published in the "Elec. Jour.," Dec. 15.

An Atlanta Exhibit.

The exhibit of the H. W. Johns Manufacturing Company in the Electricity Building at the Atlanta Exposition is conspicuously situated near the centre of the building and is devoted to a display of its trolley line and other insulating materials. The trolley insulators are displayed on sample boards and illustrate the latest and most approved forms. In addition to the trolley materials insulated with moulded mica are section insulators and crossings of the so-called Philadelphia type, made straight under run for high speed.

In a panel at the rear of the space is a tasty arrangement of vulcabeston street-car controller pieces, comprising the various parts which



An Exhibit at Atlanta.

have been used in the Walker, Curtis, Westinghouse, Sperry, General Electric, Steele and other controlling devices. Other vulcabeston parts for various purposes are also shown. These consist of field-magnet spools, brush-holder bushings, commutator rings, washers, arc lamp parts, insulating sleeves and other shapes. Special parts made of moulded mica and the black monarch insulating compositions are shown in a glass case and their use illustrated by devices in which some of the special parts are used, or which are altogether composed of the insulating material; such as the Clamond telephone pieces, showing highly polished and finished surfaces; the switches of the Electric Protective Company, of Philadelphia, and the Cutter, Hart & Hegeman and Stevens's switches.

In the centre of this case is an interesting specimen of crude asbestos, showing fibres as delicate as silk. This rests upon a sheet of vulcabeston $\frac{1}{64}$ inch thick.

One of the interesting features exhibited are the electrotherms, which are a novel arrangement of resistance wires woven with asbestos into the form of a mat. These are used for therapeutical purposes for localizing temperatures; one large mat, 3 feet by 5 feet, rendered water-proof by a casing of rubber, is shown for use on the surgical operating table. They have also been applied for heating street cars, and in this connection proven very satisfactory.

We understand that the H. W. Johns Manufacturing Company has in process of manufacture cheaper forms of insulators, which embody all recent improvements, which, however, it was too late to include in the present exhibit.

The Higham Arc Lamp.

For the problem of running two arc lamps in series on a constant-potential circuit a solution was found some time ago, but in every case this has been accomplished by means of the introduction of a wasteful resistance consuming a considerable amount of the energy. The Higham Electric Company, of 168 High Street, Boston, Mass., has designed and perfected a lamp which is made very much more economical in the use of the energy supplied, through an ingenious utilization of the principle of self-inductance. The regulators are so arranged as to be constantly oscillating the carbons, varying the length of the arc, and thus the current becomes slightly fluctuating and is capable of producing self-inductive reactions. The coil in series with the lamp is highly inductive, somewhat resembling the Swinburne hedgehog transformer. This inductance coil maintains the stability which was heretofore accomplished by means of a dead resistance, and the energy absorbed by the coil is trifling. The continual wave motion of the current is imperceptible in the burning

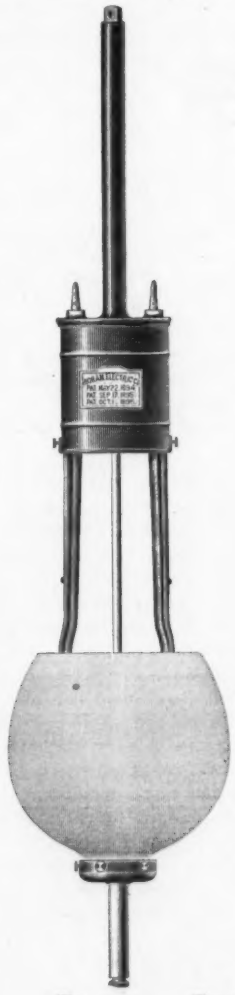


Fig. 1.

Fig. 3. Choking Coil.

Fig. 2.

The Higham Arc Lamp.

of the light, yet is sufficient to produce the effect just described. By this means as much as 92 per cent. of the total watts appear at the arcs, whereas, when a dead resistance is used for the same purpose it is difficult to obtain more than 80 per cent. The extreme condition of stability obtained by this new method is also such as to allow solid moulded car-

bons to be used, which, it is claimed, give considerably more light for the watts consumed than soft-cored carbons. The stable conditions of the lamp permit the adjustment of the lamp magnet mechanism to operate on a straight line characteristic, which is a theoretical method of obtaining absolute regulation of candle-power.

In a test of the lamps witnessed at the Higham lamp factory recently, the following results were obtained: The total voltage was 107.5 volts, while around the lamps alone it was 101.5 volts, 6 volts thus being taken up in the induction coil. Each lamp absorbed 50½ volts, and the balance between the two was remarkably steady; in fact, it was impossible to disconcert the regulating mechanism, even by forcibly blowing out one of the arcs, for it picked up again at once, the voltage being evenly divided as before. The voltage across the carbons averaged 48.9 volts, while the mechanism absorbed about 1¼ volts. These tests speak for themselves in the marked economy of the lamp. In appearance the arc is symmetrical and intensely luminous. The carbons burn evenly and quietly. Cuts of the lamp are herewith shown and also of the induction coil. While the type shown is not designed to be highly ornamental, it is substantial and serviceable, and has a neat and compact appearance.

Multipolar Series Reversible Mill Motor.

We illustrate herewith a new type of a series reversible multipolar motor and controller, manufactured by the Card Electric Company, of Mansfield, O.

The motor is shown enclosed in Fig. 1, and can be used in places where the open type of motor would soon be destroyed. In connection with the controller and current-regulator shown in Figs. 2 and 3 it is especially applicable for operating traveling cranes, turn bridges, hoists, bending rolls and other kinds of machinery which require various speeds in either direction. As mounted for general work the front of the motor is supported on a cast-iron stand rigidly fastened to the bed-plate of the machine or other foundation, with trunnions on each side of the upper part taken through suitable bearings on the motor case, forming a pivot for the motor to swing on. The rear part of the motor is supported on springs at each side, with springs above held in compression by bolts through the pedestals, which support them and which are also fastened to the bed-plate. The object for this arrangement is to provide a flexible support for the motor and a cushion for the gearing when heavy loads are thrown on the motor or the direction of rotation is suddenly reversed. In practice it has been found to work admirably, and, in addition to saving the gears, gives the motor a noticeable advantage in starting heavy loads at slow speed. Where the conditions are such that the spring suspension is not advisable, brackets are provided on the motor for bolting to the bed-plate or foundation rigidly. Special pains have been taken in the design to provide large bearings for the armature shaft and other parts subjected to strains and wear.

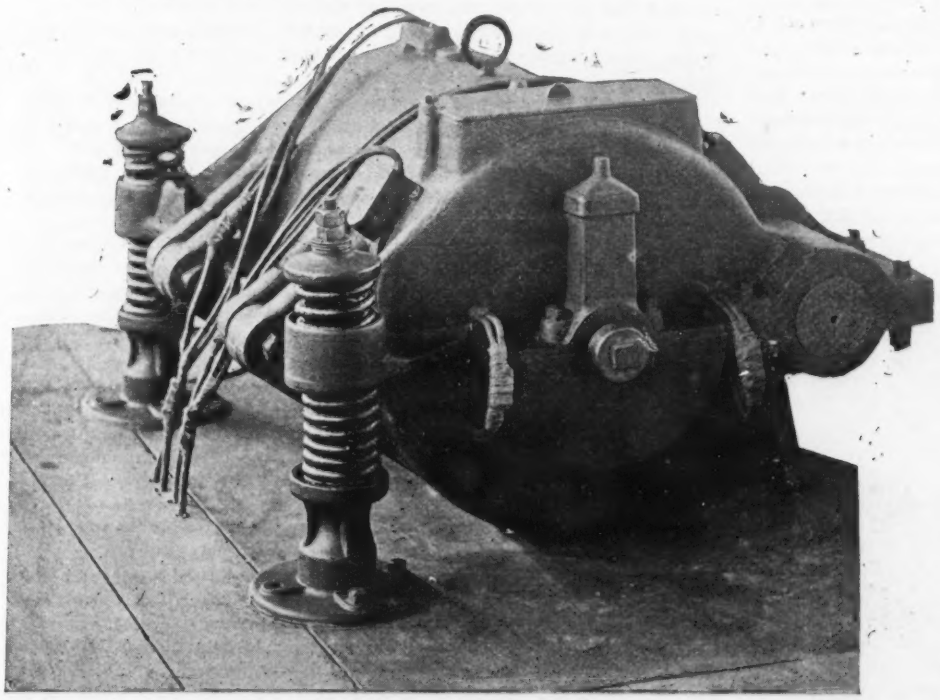


FIG. 1.—STATIONARY IRON-CLAD REVERSIBLE MOTOR.

Fig. 2 shows the controller with the lever in a vertical position for current "off," and the door open, exposing the mechanism for regulating the current. Fig. 3 shows the back removed, exposing the wiring and connections to contact fingers. The working parts are practically self-contained, and with the exception of the operating lever are fastened to a back made in one piece, which can be removed from one case to another without disturbing any of the parts. Each controller is provided with two revolving cylinders, geared together and operated by the lever, at the top of which are fastened a series of contact rings. The one at the right is used exclusively for opening and closing the circuit and has 24 contacts. These contacts are so arranged with reference to the motor-winding that arcing is impossible. A separation of 1-16

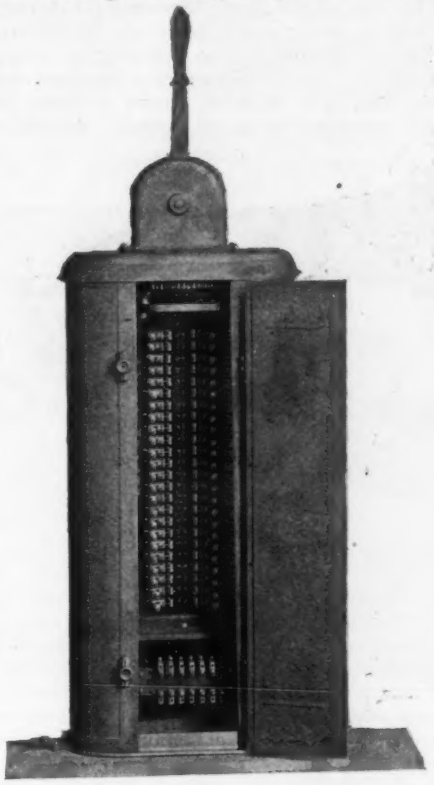


FIG. 2.—CONTROLLER WITH FRONT OPEN.

inch between rings and contact arms will open the circuit without carrying current across. The cylinder at the left carries the reversing rings, and others for regulating the flow of current through the motor. Of these latter there are 10, and the resistance between them is so proportioned that no spark follows when a change is made, no matter how slowly the lever is moved. Near the bottom of the controller are a series of binding

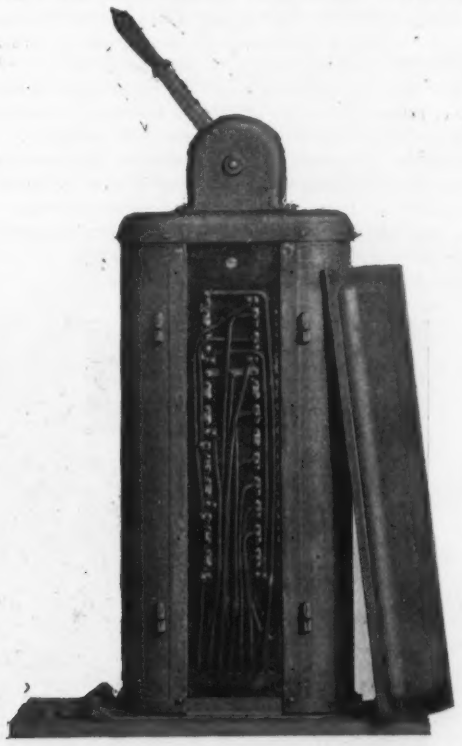
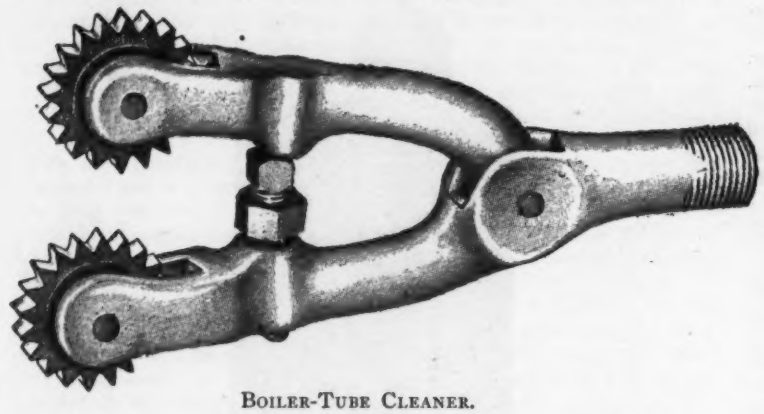


FIG. 3.—CONTROLLER WITH BACK OPEN.

blocks for making connection to the motor, current-regulator and the line. These binding blocks are plainly marked with letters and figures and correspond with others on the motor and regulator. The cylinders for starting and regulating the current are compact and strong, with ample insulating resistance for use on any circuit up to and including 500 volts, and have sufficient metal in the contacts to carry a large excess of current without heating.

Boiler-Tube Cleaners.

Boiler tube cleaners, as usually manufactured, have a spring to maintain the distance between the jaws, and when the tool is used in a tube and brought in contact with an unusually heavy deposit of scale, these springs are apt to contract sufficiently to permit the cleaner to pass over an obstruction without in any way removing it. The Haller tube cleaner, made by the McClain Manufacturing Company, of Pittsburg, Pa., and which we illustrate, provides for such cases as this, and is equally applicable to all other uses. The set-screw shown prevents the jaws from contracting, and a passage must be cut through a deposit before the tool



Boiler-Tube Cleaner.

can possibly get any farther. No injury can be done by the tool, as it is set a size smaller than the inside diameter of the tube, and its power will not be exerted except when there is a coating of scale between the cutting wheels and the side of the tube. The tool, which is the invention of a practical engineer, is constructed in the strongest possible manner, the body being of cast steel and the cutting part of the best tool steel. All the parts are interchangeable and should any of them become broken or injured in any way, they can easily be replaced.

Multipolar Dynamos and Motors.

In the front ranks of the carefully designed and substantially constructed dynamos and motors now on the market are the machines built by the Gates Manufacturing Company, of Chicago, one of which is represented in the accompanying engravings. These machines present no erratic or radically original features of design, the object being to produce plain, efficient and reliable apparatus rather than machinery embodying eccentric ideas of doubtful practical merit.

Fig. 1 shows a dynamo with the armature brushes and one pedestal removed, and Fig. 2 shows the same machine entirely dismantled. While the general design of these machines is entirely conventional, as above stated, there are some new features in the minor details which contribute to convenience of repair and handling. The commutator segments are independently removable, so that in case a single bar becomes accidentally damaged in any way it can be replaced with ease, and the necessity for turning down the whole commutator in order to "true out" the single damaged spot is obviated. Each magnet core and pole-shoe is cast in one piece of soft, low carbon steel, and bolted to the ring frame, which has very short, radial projections, faced off to make good magnetic

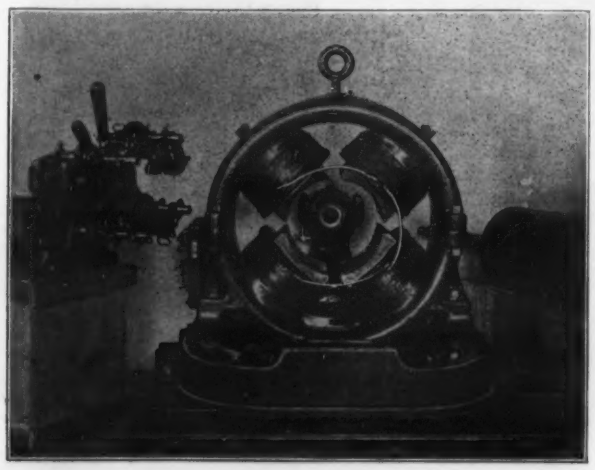


Fig. 1.—Dynamo with Armature Removed.

contact; this construction allows the removal of any magnet core and coil without removing or disturbing the armature.

The armature and commutator are mounted upon a cast-iron sleeve independent of the shaft, so that in case of accident to the latter it may be removed bodily without disturbing in the least the armature core, coils or connections. The armature is slot-wound with a flexible bar system of conductors which greatly facilitates the handling of the coils and contributes to the cool running of the machine.

Among other good features which go to make up an excellent combination are low magnetic density throughout the field-magnet circuit; low current density in armature conductors; large ratio between field and armature ampere-turns; the simplest of brush-holders and general

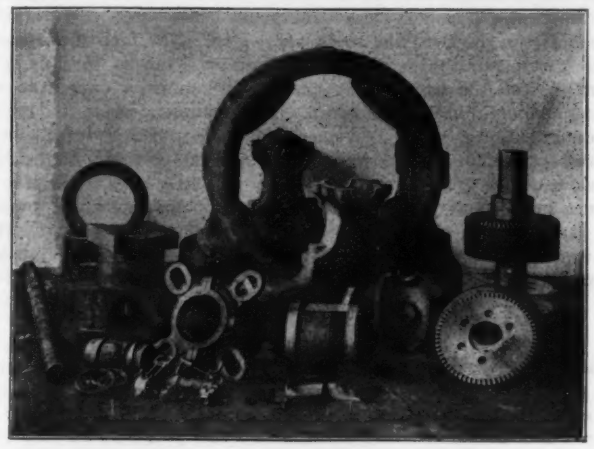


Fig. 2.—Dynamo Dismantled.

arrangement; self-aligning and oiling journals which do *not* generously distribute oil where its absence is preferable; and moderate speed. The machines are built for belt-driving or direct-connection, as may be desired.

Improvements in Engine and Dynamo Building.

The claim that for direct-connected apparatus much better results can be obtained when both engine and dynamo are built by the same company, assembled and thoroughly tested before leaving the works, is not an unreasonable one, and the entry into the electrical field for this purpose of the well-known builders of automatic engines, the J. H. McEwen Manufacturing Company, of 26 Cortlandt Street, New York, is a matter of much interest. By this combination the advantage is claimed that all parts can be standardized and duplicated, and can be turned out at less cost than is possible when the engine is built by one company and the dynamo by another in widely different localities. The complete machine, having been thoroughly tested at the works, insures quick and satisfactory starting when it reaches its destination. This feature will be appreciated by those who have had experience in this line.

The McEwen Company is well equipped for this new departure, its new works containing the latest improvements in machinery and shop convenience.

Taking up first the engine, some recent improvements have been made in the details, notably in the governor and cross-head. Fig. 1 is a cut of the governor, which is extremely simple, having but one bearing, and that a roller pin bearing, which requires no lubrication, and as the spring is the only part that is adjustable, there cannot be any trouble from misadjustment.

Fig. 2 and 3 show the construction of the cross-head. The shoes are held in position by eccentric bolts. To adjust the position of shoes for wear, it is only necessary to turn the eccentric bolt to such an extent as is necessary to give proper adjustment. It will be noticed that the shoes swivel on the eccentric bolts, so that it is impossible for the shoes to have anything but a full bearing. Both upper and lower guides, as well as the cross-head pin, are oiled from stationary sight-feed oil-cups on top of the frame. The oil is wiped off by the upper shoe, and is caught in oil grooves shown, extending across the face of shoe, and led through oil holes at each end of grooves to inside of upper shoe; thence to a funnel-shaped oil hole in strap of cross-head box to cross-head pin; from there it drops to lower shoe and then through holes in this shoe to lower guide.

The shoes are faced with genuine babbitt, which is put on in such a manner that it is as solid as though it were part of the shoe itself.

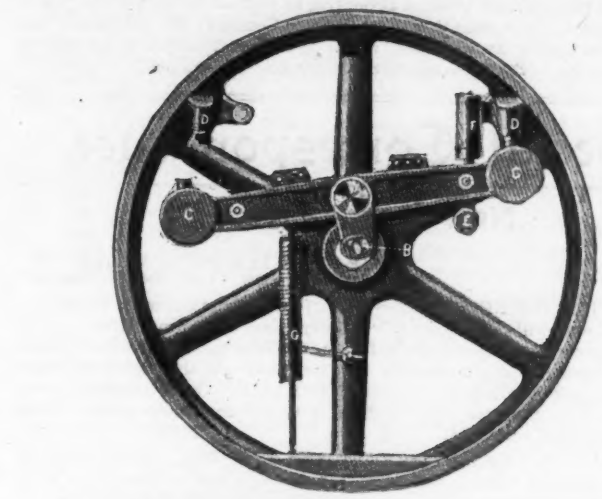
The Thompson-Ryan dynamo represents a radical departure in dynamo design, differing in nearly every detail of construction from the ordinary type of machine. The most important feature is a set of series-windings surrounding the armature, and termed balancing coils. This feature, which is the invention of Prof. Harris J. Ryan, of Cornell University, was introduced for the purpose of balancing armature reaction, and carefully conducted scientific tests show that it accomplishes the desired end perfectly.

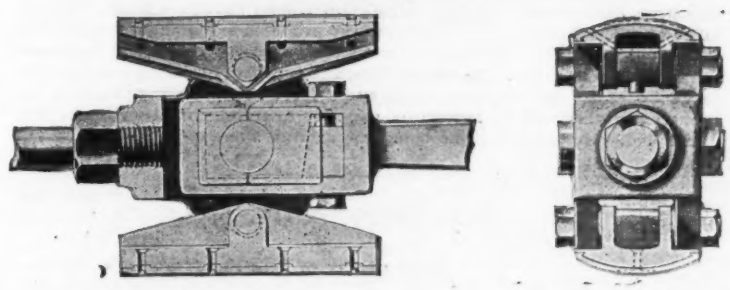
The field castings of these machines are of steel and consist of but three pieces, which are held together by four bolts. One of these castings is the "pole-ring," shown in Fig. 5, through which the balancing coils are wound, and the other two constitute the field ring proper, Fig. 7.

The balancing coils are wound in such a way that the current passes through them across the pole face in the opposite direction from the cur-

rents in the armature conductors, and thus the magnetic effects of the armature currents are neutralized.

Fig. 6 is a view of the completed pole ring. The field ring, Fig. 7, shows on its internal periphery the "pole necks," around which the coils are placed. It will be seen that the field ring is of such a shape as to entirely enclose the field coils, thus thoroughly protecting them from mechanical injury. It will be noted also that the space in the field ring allowed for the field coils is unusually small, and it is claimed that therefore less than one fourth as much energy is required to magnetize the fields of this dynamo as is necessary for a machine of equal capacity of ordinary design. On account of the small amount of field energy required, the rise in temperature of the field coils is very slight, notwithstanding





FIGS. 1, AND 2.—ENGINE GOVERNOR AND CROSS-HEAD.

the fact that these coils are so nearly surrounded on all sides. No compound winding is used on these dynamos, since, it is claimed, the balancing coils afford a compounding vastly more effective than the compound coils of the ordinary dynamo.

All of the armatures for the Thompson-Ryan dynamos of whatever capacity, and whether wire-wound or bar-wound, are constructed on the same general style. The cores are built of thin plates of a special steel, the distinctive feature of which is its unusually low hysteresis loss. The plates are stamped out in the form of rings, and a series of long slots are punched near the edges. These rings are then clamped firmly to a central hub or spider by means of brass end plates. There are no bolts passing through the laminated core, and no iron comes in contact with these plates. As a consequence of this there is no leakage of magnetism and no development of potential in any part of the core to cause eddy currents and waste energy. The holes in the plates form "tunnels," in which the armature windings are placed. Fig. 9 gives a very good idea of the appearance of the finished armature core.

It will be noted that the slots or tunnels are of unusual depth for this style of armature. Another peculiarity of this machine is the large number of poles used. This feature, which in ordinary designs would be bad practice, is a valuable one of this peculiar style of design, enabling the builders to greatly shorten the armature conductors, and to use on all their armatures what may be described as the cylindro-hexagonal style of drum winding. In this winding, all parts of every conductor of any particular layer on the armature lie in the same cylindrical surface, and the windings do not bend down over the end of the armature core at any point, and the conductors being placed through the core and below the surface, no binding wire is necessary.

The commutators are, as a rule, large in diameter and comparatively short in length. They are not mounted on the shaft, as is the usual practice, but are carried by a projecting ring of the spider. Fig. 10 is a view of the completed armature for a 200-kw direct-connected railway generator.

One of the noticeable features of these armatures is the ventilation. The armature being large in diameter, the central opening is also large and extends entirely through the armature from end to end, thus affording large heat-radiating surface. The principal ventilation is effected by the winding itself. The conductors cross one another in such a way as to form a sort of open lattice-work with innumerable radial openings through which the air circulates in great quantities, thus exerting a powerful cooling effect.

Fig. 7 is a view of complete brush-holder arrangement. The brush-holders project outward, and leave the entire outer end of the commutator free and accessible. The holders are very simple, and hold the brushes in such a way that they require no adjustment, but have only to be slipped into the holder. Working with brush-holders absolutely fixed, there is entire freedom from sparking under any and all conditions of load.

The whole brush-holder arrangement is adjustable around the commutator, and by loosening the clamp bolts, the brushes may be shifted back-

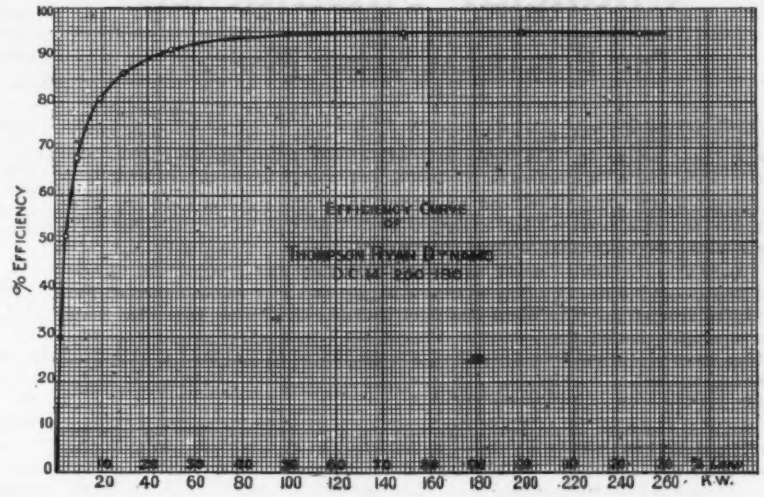
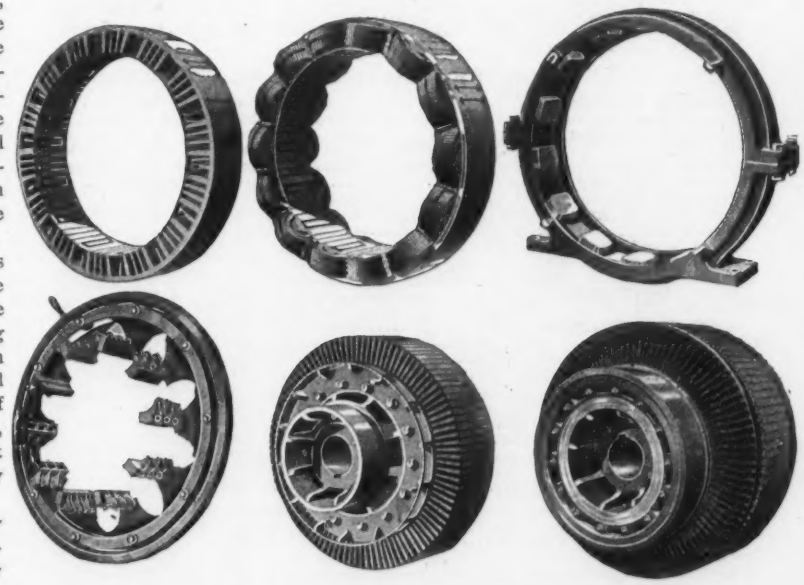


FIG. 4.—EFFICIENCY CURVE.

ward or forward. This is only done, however, for the purpose of adjusting the compounding of the machine. By shifting the brushes in this way the machines may be adjusted through a range of from 10 per cent. drop at full load to 10 per cent. rise, and this without any effect whatever on the commutation.

Fig. 4 shows a curve of commercial efficiency taken from actual tests of a Thompson-Ryan 200-kw generator. The peculiar features of this curve are not so much the good efficiency under heavy load as the unusually high efficiency under light loads and the very great range of uniform efficiency. This is due to the unusually small fixed losses, the result of the very small field energy consumed and of the small losses in the armature core.

Another feature of the dynamo is the great ease with which two or more machines may be worked in parallel. The design of the machine peculiarly fits it for this sort of service. They may be thrown in parallel while differing widely in voltage produced, and each machine will take its due proportion of the load, notwithstanding the fact that they may be greatly over-compounded. Two or more of these machines will work



FIGS. 5, 6, 7, 8, 9 AND 10.—DETAILS OF DYNAMO.

perfectly in parallel, and divide the lightest load evenly or maintain perfect unison with the entire load thrown off.

The Thompson-Ryan dynamos are built in sizes from 12½-kw to 1500-kw capacity, both belted and direct-connected.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Dec. 21, 1895.

THE ELECTRICAL STOCK LIST has shared the general demoralization which has characterized the whole market this week, following the publication of the President's Venezuelan message, and many stocks have suffered severely.

THE TRACTIONS have been no exception to the general decline. The various stocks, almost without exception, have been offered down, while very few sales have been made at great concessions.

BUFFALO RAILWAY stock has held firmer than the general list. After selling at 70¾ the stock quickly advanced to 72½, and only sold off toward the close to around 70. The State Board of Railway Commissioners, who have been considering the application of the Buffalo Traction Company for a franchise, have adjourned until the 30th of this month, when the final arguments, for and against, will be heard. The present would not seem to be a favorable time for the issue of any new securities.

NEW ORLEANS TRACTION stocks advanced sharply during the early part of the week, but shared the general demoralization at the close. Sales of the preferred are reported as high as 69¾, while it was offered freely at 68 to-day. The common reacted from 20¼ to 18. The upward movement was attributed to the reports of increased earnings, which the company publishes from time to time.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	95¾	97½
" " " Brooklyn	100	110	115
" " " Boston	100	145	150
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	..	24½
Electric Storage, pref	100	24¼	..
General Electric	100	22¾	23½
General Electric, pref	100	60	63
Westinghouse Consolidated, com	50	..	30
" " pref	50	54	54½

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	191	192
American District Telegraph	100	25	30
American Telegraph & Cable	100	..	95
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
†Erie Telephone	100	57	58
Gold & Stock Telegraph	100	105	..
New England Telephone	100	..	85
Postal Telegraph-Cable	100	82	83
Western Union Telegraph	100	83¾	84

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	15¼	15½
Binghamton RR. com	100	100	..
Brooklyn Traction	100	11	13
" " pref	100	59	61
Buffalo St. Ry	100	72½	73
Cleveland City Ry	100	69	70
Cleveland Electric Ry	100	59	60¾
Columbus St. Ry	100	47	50
Hestonville	100	..	51⅝
Long Island Traction, all pd	100	14½	15½
Louisville St. Ry. com	100	37	39
" " pref	100	87	88
New Orleans Traction	100	19	20
" " pref	100	67	68
North Shore Traction	100	32	34
" " pref	100	83	85¼
Philadelphia Traction	50	64	..
Rochester St. Ry	..	..	37
Steinway, Ry	..	46	..
Union Ry. (Huckleberry)	100	112	115
Union Traction, rcts $5 pd	..	11	11½
West End, Boston	100	70	70½
" " pref	100	93	..
Worcester Traction	100	15	17
" " pref	100	84½	86½

BONDS.

Buffalo St. Ry. 1st con. 5s	100	104	105
*Binghamton Railway Co. 5s	100	99	100
Cleveland Elec. Ry. 1st mtge 5s	100	102	104
*Columbus St. Ry. 1st 5s	100	98	101
Rochester St. Ry. 1st 5s	100	102½	104
*Union Ry. 1st mtge 6s	100	105	108
*Westchester Electric 1st mtge 5s	100	98	101

* With accrued interest.
† Ex-Div.

BROOKLYN CITY RAILWAY STOCK has declined about 16 points. This however, is probably due to the various lawsuits in which Long Island Traction (the parent company) is engaged, and to the dispute regarding the ownership of part of the so-called Plaza in Brooklyn, as well as to the general weakness in the market. The contest with the Nassau Company for franchises has not yet been decided in favor of either road. Brooklyn Traction is also heavy and dull. The rest of the list is inactive at very general declines.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Dec. 23, 1895.

DURING THE COMING YEAR the H. W. Johns Manufacturing Company, of 87 Maiden Lane, will offer to electric railways and others interested in trolley line and insulating materials some forms of insulators which have proved to be most advantageous and reliable. The company will also put on the market some new designs which, it is expected, will prove to be attractive, and in which will be maintained the high standard of excellence characteristic of all the Johns insulating materials.

THE PECK ELECTRICAL COMPANY.—Mr. E. F. Peck, vice-president of the National Electric Light Association, who for the last 10 years has been the general superintendent of the Citizens' Electric Illuminating Company, of Brooklyn, has formed a company to be known under the above name, with an office at 15 Cortlandt Street. The company proposes to manufacture and deal in electrical specialties and supplies and also to engage in electrical engineering in all its branches. Mr. Peck's long and practical experience as superintendent of one of the largest and most successful electric lighting plants in the country, together with his recognized capacity as an electrical engineer, will undoubtedly command for the company a large share of public and private patronage.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Dec. 20, 1895.

PROF. WILLIAM ESTY, of the University of Illinois, has been promoted from the position of instructor in electrical engineering to that of assistant professor, and Mr. Sager, who has been instructor in physics for the past year, has been made assistant professor in that department.

MR. JOSEPH FRANKLIN, president of the Commercial Electric Supply Company, St. Louis, is spending a few days in Chicago looking after the interests of his company. He reports business with them is flourishing in spite of the keen competition they have to contend with in St. Louis.

THE ST. LOUIS ELECTRICAL SUPPLY COMPANY, of St. Louis, is now busily engaged in preparing a new and complete catalogue of its various electric light, power and street-railway supplies and specialties, and expects to issue the book about the first of the year. This catalogue, it is said, will compare favorably with anything in this line ever brought out.

GEORGE W. CONOVER, Western manager for the Perkins Electric Switch Manufacturing Company, of Hartford, Conn., has returned from a visit made to his factory in the interest of Western buyers. Under Mr. Conover's intelligent and courteous management, the business of the Perkins Electric Switch Manufacturing Company in the West has assumed large proportions, and unless all signs fail, 1896 will surpass any previous year.

CANADIAN NOTES.

OTTAWA, Dec. 19, 1895.

LEVIS, QUE.—The proposed system of electric light is estimated to cost $180,000.

DIGBY, N. B.—The New France Milling Company will build an electric railway.

ST. CATHARINE'S, ONT.—The ratepayers will probably vote on a by-law next month to establish a civic electric plant.

MONTREAL, QUE.—The Royal Electric Company has secured the contract for lighting Logan Park, Brock Street Tunnel and Lachine Canal.

CALAIS, N. B.—A long-distance telephone line is to be constructed next spring between Calais and other places in New Brunswick, connecting with Boston.

CHICOUTIMI, QUE.—The new electric plant at Chicoutimi is now in operation. The cathedral, seminary and archbishop's palace will be lighted with electricity.

HULL, QUE.—Contractor Viau states that he will shortly make an offer to the Council to light the streets by electricity. The Council, on the other hand, is considering the purchase of a plant.

VANCOUVER, B. C.—The Western Light, Heat & Power Company has applied for a charter; object, general electrical business. The promoters are C. D. Crandell, J. E. W. McFaren, George H. Cowan, and William T. Steward.

HAMPTON, N. B.—Hampton will in all probability soon have the electric light. Cecil March has already secured a large number of signatures to contracts for the use of electric service. Electric cars are talked of, too, between Hampton and St. John, N. B.

NEWMARKET, ONT.—A meeting was held recently in regard to the proposed Ontario & Lake Huron Electric Railway, at which Mr. Pey, the promoter, stated that he had been requested to extend the line to Goderich by way of Wingham. The Dominion and Provincial governments have granted bonuses to the extent of $6200 a mile.

SCHOMBERG, ONT.—L. E. Hambley, who is interested in the proposed electric railway between Aurora and this village, was here recently in connection with the scheme. He stated that the probable cost of the road would be about $200,000, and that the bonus by-law would be submitted to the municipalities as soon as a government charter is secured. A. B. Armstrong, of Toronto, is solicitor for the applicants.

MONTREAL, QUE.—The Street Railway Company has been granted the permission by the Road Committee to build a line on Mount Royal Avenue. The extension will mean about four miles of additional track.

The sale of real estate and other property of St. Jean Baptiste Electric Company (in liquidation), took place on Dec. 19, at the office of Mr. Charles Desmarteau, the official liquidator. The whole property was disposed of, Hon. L. Tourville being the purchaser for the consideration of $53,000. The book debts, which aggregated $3700, were sold at 35 cents on the dollar.

QUEBEC, QUE.—The shareholders of the Montmorency Light & Power Company, at a meeting held on Dec. 11, decided to accept the offer of the Electric Street Railway Company for the purchase of the stock and franchise of the former company.

Mr. Beemer is pushing his scheme along to consolidate all the electric and street railways in and around Quebec. The stockholders of Montmorency Electric Power Company are called to meet to-morrow to decide whether they will accept the Beemer offer. This contemplates the purchase of the whole stock by the company represented by Mr. Beemer at the rate of 15 per cent.; that is to say, 50 per cent. above par, and of 38 per cent. over its actually quoted value. Mr. Beemer's scheme calls for a capital of $2,500,000, and there are New York and Baltimore capitalists ready to put their money in it.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Dec. 11, 1895.

GOVERNMENT ELECTRICIANS.—Mr. A. P. Trotter, who was for some five years editor of *The Electrician*, has been appointed to the post of Electrician and Inspector to the Government of Cape Colony, a post which has just been created by the Electric Lighting & Power Act of the present year.

ELECTRIC LIGHTING & TRACTION FRANCHISES.—All companies and individuals wishing to obtain parliamentary powers for supplying electricity for lighting purposes or for electric traction, are obliged to publish their intention in an official journal known as the *London Gazette* twice during the months of October and November. The number of these advertisements forms a very fair criterion of the electrical activity in these two directions, which may be expected during the next twelvemonth or so. This year there are 41 electric lighting notices as against 32 last year, 28 of the notices being given by local authorities. The electric traction notices exhibit a marked increase, there being 37 in all, as against 13 last year and 17 the year before. An unusual feature of the notices this year is to be found in the fact that four gas concerns are seeking power to supply electric current.

MUNICIPAL AUTHORITIES AND ELECTRIC LIGHTING.—The continuity of the responsibility of local authorities has recently met with a striking exemplification at Fareham, a small town close to Portsmouth. Fareham has been blessed for some years with a struggling electric light company, and a little while ago, just previous to the municipal elections, the Fareham local authority, which was largely composed of members interested in the electric light company, decided by the casting vote of the chairman to purchase this struggling concern, which had by then nearly struggled into bankruptcy. This step was taken by the local authorities in face of a number of hostile meetings of the rate-payers, and notwithstanding that the elections were going to take place within a few days. The result of the elections was that the Fareham Local Board was completely transmogrified, all the members who had voted in favor of the acquisition of the bankrupt electric lighting concern being thrown out. The new board thereupon endeavored to wriggle out of the contract which had just been entered into, but to no purpose. An action was brought against it by the electric light company, and the Lord Chief Justice of England decided that the local authority not having fulfilled the contract entered into must pay damage to the extent of £3800 and the costs of the action. In this way the continuity of the responsibility of local authorities from one election to another has been vindicated, but it must be confessed that the rate-payers of Fareham deserve commiseration.

THE BOARD OF TRADE AND "LOW PRESSURE."—The report of the special committee appointed by the Board of Trade to consider the revision of the definition of "low pressure," has been published. As I foreshadowed in my last letter, it is of a satisfactory nature. In future "low pressure" supplies will be deemed to be those in which the pressure, at no time, exceeds 500 volts continuous, or 250 volts alternating. High pressure supplies will be those in which the pressure cannot exceed 3000 volts, and extra-high pressure supplies will be those in which the pressure may attain an amount exceeding 3000 volts. I do not think the distinction in the low pressure definition, between continuous and alternating current supplies, will be altogether to the liking of current men. Whether it will be of much practical import is doubtful, since, on the system which is now almost universal in this country, viz., 200-volt feeders terminating in transformers feeding 3-wire net-works, the maximum pressure permissible on the 3-wire side of the transformer is not so important as in the case of an ordinary 3-wire system. No pressure exceeding 250 volts is to be permitted inside a consumer's house. The neutral of a 3-wire system may, in future, be "earthed at any one point" whenever the Board of Trade are satisfied that a high insulation is maintained on all other points of the system, and suitable and sufficient means are provided for the immediate detection, localization, and correction of any fault. With a view of preventing constant wholesale changes in the pressure of consumers' terminals, such as many 3-wire engineers are contemplating, in order to double the power-carrying capacity of their mains, it is provided that no change shall be made in the pressure of the supply to any consumer, in consequence of the issue of these regulations, except with his consent.

General News.

NEW INCORPORATIONS.

THE WARRIORS RUN LIGHT, HEAT & POWER COMPANY, Warriors Run, Pa., capital stock, $10,000, has been formed to supply electric light, heat and power in Warriors Run, Pa. The promoters are George McDonald, Taylor, Pa., George W. Milnes, Scranton, Pa., and John S. McGroarty, Wilkes Barre, Pa.

THE SUGAR NOTCH LIGHT, HEAT & POWER COMPANY, Sugar Notch, Pa., has been incorporated by George McDonald, Taylor, Pa.; George W. Milnes, Scranton, and John S. McGroarty, Wilkes Barre, Pa., for the purpose of supplying electric light, heat and power in Sugar Notch, Pa. Capital stock, $20,000.

THE STANDARD BUILDING COMPANY, Chicago, Ill., capital stock, $50,000, has been formed to contract for and do a general improving, constructing, repairing, building and supply business, including electrical work and public and private improvements of all kinds. The promoters are Joseph Fish, Richard Sullivan and H. A. Senf.

THE WEST SIDE SUBURBAN COMPANY, Los Angeles, Cal., has been organized for the purpose of generating electricity for light, heat and power, and for engaging in other enterprises. The incorporators are P. E. Brook, P. P. Buchanan, John McDonald, J. D. Pory, Pasadena, Cal., P. S. Montgomery, E. P. Pine, James Kerr, Los Angeles, Cal. Capital stock, $2,000,000.

THE LINCOLN STREET RAILWAY, TRACTION & LIGHT COMPANY, St. Catharine's, Ont., has been formed to construct and operate an electric railway in St. Catharine's to extend not further than a mile and a half beyond the limits of the town; also to distribute electricity for light, heat and power. The incorporators are R. H. Hill, H. A. King, of Toronto, J. S. Campbell, Dr. L. S. Oille and George E. Patterson, of St. Catharine's. Capital stock, $90,000.

THE BOYTON BICYCLE TRACTION COMPANY OF FRANCE, New York City, N. Y., has been incorporated in West Virginia, for the purpose of acquiring letters-patent for appliances, devices, etc., for generating light, heat and power by electricity, steam, etc., and for the purpose of constructing railways. The promotors are Jose F. de Navarro, Thos. E. Sotolongo, Mariano de Cossio and George R. Cullingworth, New York City. Capital stock, minmum $10,000., maximum $5,000,000.

TELEGRAPH AND TELEPHONE.

ROCK RAPIDS, IA.—The Clark Automatic Switch Company, of Sioux City, has been granted a franchise to put in a telephone system at Rock Rapids.

YOUNGSTOWN, O.—The Council has granted a franchise to Morgan T. James, to operate a telephone exchange and establish circuits in the streets of the city.

ROCKFORD, ILL.—The City Council has passed an ordinance granting a franchise to the J. B. Whitehead Company to construct and operate a telephone exchange.

PARKERSBURG, W. VA.—Capt. S. F. Shaw is organizing a stock company to build a telephone line from Parkersburg to Waverly. Application for a charter has been made.

LYONS, N. Y.—The Wayne Telegraph & Telephone Company, has been granted a franchise to erect poles and string wires for an electric telephone and telegraph service.

GETTYSBURG, PA.—R. H. Hazlitt, general manager of the Western Maryland Telephone Company of Westminster, Md., is in Gettysburg endeavoring to establish a telephone company.

MARYSVILLE, KY.—There is talk of building a telephone line from Flemingsburg to Moonfield, which will give Marysville connection with Carlisle, Sharpsburg, Mt. Sterling and other points.

TOPEKA, KAN.—A company has been organized to build a telephone line from Salina to Kansas City. A. K. Rogers and Simon Greenspan, of Topeka, and C. W. Glick, of Atchison, are interested.

WILMINGTON, DEL.—A director of the Delmarvia Telephone Company has stated that the list of subscribers now numbers about 800, and that the construction of the line will be commenced within 60 days.

ROCHESTER, IND.—At a regular session of the City Council a franchise was granted to the Rochester Telephone Company, J. M. Brackett, Joseph A. Myers, George W. Holman, R. C. Stephenson and H. A. Barnhart are interested.

WASHINGTON, D. C.—Supt. Henry R. Miles, of the District Police and Fire Alarm Service, reported to the commissioners that all the overhead wires in use located on United States Government poles will be placed underground as soon as possible.

SPRINGFIELD, ILL.—J. L. Stryker and W. C. Garrard, of this place, have been in Decatur to look over the plant of the Citizens' Mutual Telephone Company. A company of local capitalists has been organized in Springfield for the purpose of putting in a similar plant.

ELECTRIC LIGHT AND POWER.

SPRING VALLEY, N. Y.—Electric lights are to be established in Spring Valley.

UNION, S. C.—An electric light and water works plant will probably be established at Union.

TRENTON, N. J.—The Light Committee of the Common Council will soon advertise for bids for electric lighting.

ATHENS, MICH.—Rheubottom & Bond, of Union City, expect to put in an electric light plant at Athens this Winter.

TULLY, N. Y.—Electric lights are being talked of in connection with the water-works plant, now nearly completed.

KNOXVILLE, TENN.—The Tennessee Electric Light & Power Company will spend $20,000 on improvements of its plant.

BEATRICE, NEB.—A committee has been appointed to consider the question of the city acquiring its own lighting plant.

DE WITT, IA.—The citizens will vote on Dec. 27 on the proposition of granting a franchise to establish an electric light plant.

ELGIN, ILL.—The Aldermen are planning to make many improvements next year, which will include electric light extensions.

MIDDLETOWN, N. Y.—Bids will received for additional electric lighting at Middletown State Homœopathic Hospital, until noon, Jan. 4.

MONTPELIER, VT.—The United States Clothes Pin Company, of Montpelier, contemplates the addition of electric power machinery.

GAINESVILLE, FLA.—Graham, Taylor & Co. has asked for a franchise for the operation of an electric light and street-railway plant in Gainesville.

ROCKWELL, IA.—A meeting of Rockwell business men was held recently, to discuss the question of an electric light plant for Rockwell.

BENTON HARBOR, MICH.—Preliminary steps are being taken by the City Council to secure an electric lighting plant, to be owned and operated by the city.

SPRINGFIELD, ILL.—The Committee of Court House and Jail has been directed to prepare specifications for wiring the Court House and jail for electric lights.

ASHLEY, PA.—The Ashley Light, Heat & Power Company has applied to the authorities of the borough for permission to erect poles and run wires over the streets of the city.

CHESTER, PA.—Several parties have been considering the advisability of using the water-power of Ridley Creek to operate an electric light plant for the upper end of the city.

DENVER, COL.—Sealed proposals will be received by the secretary of the Board of Capitol Managers, until 12 m., Dec. 27, for 20 iron electric light poles for the Capitol grounds.

CHATHAM CENTER, N. Y.—The electric light plant belonging to Henry C. Spangler, at Chatham Center, which supplied light to the village, has been destroyed by fire. Loss, $12,000.

BOWDLE, S. D.—A company, composed of Clark Hudson, W. W. Brant and the Bowdle Milling Company, has been formed for the purpose of putting in a system of electric lights in the city.

TAUNTON, MASS.—At meeting of the Board of Aldermen the Committee on Street Lamps reported that it was expedient for the city to own its own lighting plant, and the report was adopted.

SALINA, KAN.—Wm. Tracy, representing Leavenworth capital, is here for the purpose of soliciting patronage for a new company to be known as the Salina Light, Heat & Power Company.

MINERSVILLE, PA.—The Minersville Electric Light Company is making a number of improvements. They are at present installing a 225-hp Ball engine, built by the Ball Engine Company, of Erie, Pa.

FREEPORT, L. I., N. Y.—The parties who are arranging for the lighting of Rockville Centre and other south side villages are negotiating for a permit to run the poles and wires through the village of Freeport.

KENNETT SQUARE, PA.—Kennett Square has about decided to light the streets with electricity, and a meeting of the Electric Light Company and the Borough Council has been called to look into the matter.

ST. LOUIS, MO.—Arrangements have been completed for the erection at the corner of Ninth and Pine Streets, of what has been known as the Benoise Building. When completed it will be provided with elevators and an electric light plant.

COLUMBIA, S. C.—The Columbia Water Power Company intends to erect at an early day an extensive electric power-house at the foot of the canal, generating from 6000 to 8000 horse-power, and furnishing power for the operation of cotton mills.

UTICA, N. Y.—A Council Committee has been appointed to investigate and report concerning the advisability of the ownership and operation of an electric light plant by the city. The committee consists of Aldermen Jones and Conley, and City Surveyor Johnston.

TOLEDO, O.—One of the results of the inspection of the infirmary by the County Commissioners will probably be the introduction of electric lights. As the building is already equipped with boilers, it is thought that an electric light plant can be put in without much trouble or expense.

HARRIMAN CITY, TENN.—Supt. Brown has made a report on the cost of incandescent lights, estimating the cost of a plant to furnish 600 incandescent lights at $4,310 and a 1,000-light plant at $5,000. The Mayor, superintendent of water and lights, and chairman of the Finance Committee, are to devise ways and means to erect the plant.

COLUMBUS, O.—Sealed proposals will be received at the office of the Board of Public Improvements until Jan. 4, for lighting by electricity the streets, avenues, etc., of the city, in accordance with plans and specifications on file in the office of the Board, for a term of ten years from the date of the contract. Jared P. Bliss is chairman of the Board.

TRENTON, N. J.—Sealed proposals will be received by the Common Council at 8 p. m., on Jan. 7, 1896, for furnishing and operating 250 or more arc lamps of 1500 or 2000 cp nominal. The lighting contract will date from March 1, 1896, and cover a period of three or five years, as may be ultimately determined. Blank proposals and information may be had from the City Clerk.

THE ELECTRIC RAILWAY.

STROUDWATER, ME.—The Stroudwater Electric line is to be rebuilt in the Spring.

GEORGETOWN, KY.—The town is to have a street railway and an electric power plant.

SCRANTON, PA.—The Traction Company proposes to double track the line on Robinson Street.

JOHNSTOWN, N. Y.—The Amsterdam Street Railway Company will extend its line in Johnstown.

KINGSTON, N. Y.—The Rondout & Eddyville Electric Railway Company has received its franchise.

CORRY, PA.—A charter has been issued to the Corry Street Railway Company to build a line four miles long.

BRADFORD, PA.—An ordinance granting a franchise to the Bradford Electric Street Railway Company has been adopted.

McKEESPORT, PA.—The building of the McKeesport & Port View Passenger Railway will be begun with the opening of next Spring.

EAST CORINTH, ME.—An electric railway is projected between Bangor and Charleston. T. J. Peaks and Ira W. Davis are interested.

CHICAGO, ILL.—The Englewood & Chicago Electric Street Railway Company has secured a permit to lay tracks under the franchise which it secured May 1, 1893.

DENISON, PA.—Major C. E. Mitchener, of New Philadelphia, has been granted a franchise for the proposed street railway between New Philadelphia and Urichsville.

ORANGE, N. J.—The receiver of the Suburban Traction Company is preparing to build an extension to the road to connect with the South Orange & Maplewood line.

BALTIMORE, MD.—The City Passenger Railway Company has had introduced in the City Council a number of ordinances providing for the extension of its system.

EASTON, PA.—It is reported that the Lehigh Valley Railway Company will build an electric line from Valley, N. J., on its main line to Lake Hopatcong. The route is now being surveyed.

CHEBOYGAN, MICH.—William Blake has announced that he will start the construction of a new line, between Cheboygan and Petosky, as soon as the weather will permit, in the Spring.

BUFFALO, N. Y.—The Cross-town Street Railway Company has made application for permission to extend its lines, and the Buffalo Traction Company has made a similar application.

KANSAS CITY, MO.—An ordinance was introduced in the Council recently providing for the grant of a franchise to the West Side Railway Company for an electric railway on Wyandotte Street.

ANDERSON, IND.—Hon. C. L. Henry, president of the Anderson Electric Street Railway Company, is advertising for bids for the construction of a railway roadbed between Alexander and Anderson.

GREEN CASTLE, PA.—A new electric car line is projected at Green Castle by Hugh Keogh, a contractor of Lancaster, Samuel A. Miller and Edward Saxman, of Latrobe, and some Pittsburg capitalists.

CARROLLTON, KY.—Carrollton has a scheme to build a bridge across the river. If the town will raise $20,000, a company has agreed to build the bridge, and an electric road will also be built connecting Carrollton with several smaller places.

ELIZABETH, PA.—A charter has been granted to the Pittsburg & Monongahela Traction Company. M. D. Bulger, of Brownsville, is president. The line will begin at West Elizabeth, and run through the streets of Elizabeth and West Elizabeth.

TACOMA, WASH.—H. E. Thomas, a civil engineer, of Seattle, who is said to have eastern capital behind him, has been looking over the ground for an entrance to Tacoma, for an electric railway, to be built between Tacoma and Seattle, distance, 32 miles.

TAUNTON, MASS.—The Fall River & Taunton Street Railway Company has petitioned for an amendment to its charter, which will extend its rights as a corporation to July 1, 1900, and permit it to build and operate a street railway between New Bedford and Taunton.

GREENSBURG, PA.—An electric railway starting at Derry and running to Latrobe, Youngstown, Whitney, and the extensive Lippincott and Hostetter coke plants, and to St. Xavier's Academy, is shortly to be built by local capitalists. The road will be 20 miles in length.

AMHERST, MASS.—The committee appointed to solicit subscriptions for the Amherst electric road is meeting with success. C. A. Richardson, of the Worcester Construction Company, advises the promotors of the road to go through Sunderland, instead of stopping at North Amherst.

AKRON, O.—The consolidation of the railway and electric lighting companies, under the name of the Akron Street Railway & Illuminating Company, has received its charter. All the machinery will be placed in the power-house of the electric lighting company, that of the street railway company being abandoned.

MADISON, IND.—The City Council has passed a resolution empowering the Select Committee, to whom was referred the matter of electric light and street railway, to contract with a competent electrical engineer, to draw plans and specifications for a street lighting and electric street railway plant in the city of Madison.

PITTSBURG, PA.—A charter has been granted to the City Incline Plane Company, the object of which is to build an incline railway from a point on Fourth Avenue, over the Monongahela River, to the top of Mt. Washington. The structure will be 3500 feet in length, 40 feet wide, and have double tracks. John S. Moore, general superintendent of the Knoxville Land Improvement Company, is interested.

PRINCETON, IND.—It is reported that the Princeton Inter-Urban Electric Railway Company has been granted a 20-year franchise by the City Council. The company is composed of citizens of Princeton and capitalists of St. Louis, Chicago and Louisville, and it is said that an electric street car system will be put in in Princeton within the coming year, and that other lines will ultimately be built to neighboring towns.

FORT WAYNE, IND.—A Cleveland syndicate, headed by John J. Shepherd, has just closed a deal by which the entire street car system of Fort Wayne comes into its hands. The capitalization of the consolidated company is $1,500,000 and a mortgage of $1,500,000 has been filed to cover the bonds of the company. It is stated that the syndicate will spend $300,000 in improvements on the property, extensions and additional equipments being intended.

MILLBRIDGE, ME.—Articles of association have been filed with the Railway Commissioners at Portland, by the company which proposes to build a branch road from Millbridge to Cherryfield. The corporation is to be called the Cherryfield & Milford Street Railway Company, and the road will start from Cherryfield, so as to connect the Washington County Railway, at or near the upper corner, so called, and run thence south through Main Street to Smith Street

FOREST LAWN, N. Y.—An electric railway to run from Forest Lawn to Summerville, along the shore of the lake is now practically assured. Articles of incorporation for a company to build and operate such a line have been filed. The company will be known as the Windsor Beach & Summerville Electric Railway Company. E. O. McNair and H C. McNair, of Warren; A. G. Johnson, J. C. Tone, F. W. Elwood, Edward Ellwanger, George Wilson, and others of Rochester, are interested.

MISCELLANEOUS.

THE BROOKLYN ELECTRICAL SOCIETY.—The lecture by Mr. Harry G. Dey, "Hydraulic Power as Applied to Electric Motors," which was to be delivered on Sept. 17, has been postponed until Jan. 7, as the society was unable to finish its lanterns and slides in time.

Trade and Industrial Notes.

THE SHULTZ BELTING COMPANY, of St. Louis, has recently made the following shipments: One thousand eight hundred feet of belting to Moscow, Russia; 1000 feet to London, England, and 4000 feet to Sweden.

STORAGE BATTERY TESTS.—In our issue of Dec. 14 we referred in this column to a report by Messrs. Houston and Kennelly on some tests made by them on a storage battery. The battery tested was not, however, the Hatch battery, as stated, but the Hess storage battery.

A HANDSOME ISOLATED ELECTRIC LIGHT PLANT is that in the building of J. N. Adam & Co, in Buffalo, N. Y. The firm has recently added to its already large plant a 110-hp tandem-compound automatic engine, from the Ball Engine Company, Erie, Pa., direct-connected to a 65-kw Eddy dynamo.

THE LAFAYETTE ENGINEERING & ELECTRIC WORKS, Lafayette, Ind., have been working night and day for nearly two months in the effort to keep up with orders. The company has a fine, modern plant, and makes an excellent dynamo and motor, the merits of which are receiving due recognition, as the conditions above noted testify.

MR. E E. CARY, formerly identified with the Beacon Lamp Company, has accepted the position of general manager for the Packard Electric Company, Limited, of St. Catharine's, Ont. This enterprising company has a magnificent plant, with unlimited water-power, at St. Catharine's, and is manufacturing the well-known "Packard" lamp and transformer. The company also handles a complete line of supplies.

G. F. EVANS, proprietor of the Evans Friction Cone Company, 85 Water Street, Boston, reports an increasing demand for the Evans friction cone pulleys, which is not at all surprising, as the merits of these devices have long been recognized. The list of installations covers some of the largest manufacturing establishments in the country. Forty-seven different sizes of pulleys are manufactured, transmitting from 1 to 40 horse-power, and adapted to change the speed of all kinds of machinery while running.

APPRECIATION is gratifying, and especially so when it is merited, and therefore the Mica Insulator Company, of 218 Water Street, New York, has ample justification for the pride with which attention is called to a letter from the Fort Wayne Electric Corporation, in which it is stated that the company has "found nothing better than 'Micanite'" for insulating its high-potential machinery, for which work it is, of course, imperative that the insulating material shall be the very best obtainable.

THE HOPPES MANUFACTURING COMPANY, of Springfield, O., reports some very nice orders during the past 60 days for feed-water purifiers and heaters, of which it makes a specialty. Among numerous other sales are orders from the Columbus, O., Railway Company for a 1300-hp heater; from E. C. Atkins & Co, Indianapolis, Ind., for a 625-hp purifier, and an 800-hp heater; from the Rochester, N. Y., Railway Company for a 2250-hp heater, and the Edison Electric Light & Power Company, Erie, Pa., for a 500-hp heater.

DIAMOND TRAP.—A very useful device has been put on the market under the name of the "Diamond" trap—not a snare for stray diamonds, but an arrangement for taking care of condensation and entrained water in steam-heating systems The trap is made by Jenkins Bros., 71 John Street, New York, and is designed for any steam-heating system using ¾ or 1 inch pipe. One of these will take care of 500 to 1000 feet of 1-inch pipe, and is entirely automatic in its operation. The traps are made in brass for general use and iron for water containing sulphur.

Business Notice.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 17, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

551,357. INCANDESCENT ELECTRIC LAMP; Charles A. Beal, Abington, Mass. App. filed Feb. 28, 1895. A socket for a double or single filament lamp, having a central contact piece, and two side contact pieces, insulated from each other and occupying the same concentric circle around the central contact piece.

551,364. MAGNETIC ELECTRIC LAMP-HOLDER; Martin H. Collom, Denver, Col. App. filed June 12, 1895. The combination with an incandescent electric light socket of a magnet in circuit therewith having magnetic exposed surfaces, and means for securing said magnet to said socket and for encasing the same.

551,371. MEANS FOR OPERATING AND REGULATING SPEED OF ELECTRIC MOTORS; Rudolf Eickmeyer, Yonkers, N. Y. App. filed Dec. 31, 1892. The combination substantially as hereinbefore described of an electric motor, provided with a governing field coil, a governing dynamo driven by the motor, and a switch for controlling the line current connections with the motor and with the dynamo, and also controlling the delivery of the current generated by the dynamo to the governing field coil of the motor.

551,388. STRONG CURRENT PROTECTOR; Adrian L. Joynes, Paducah, Ky. App. filed Jan. 9, 1895. In a strong current protector, the combination of electric conducting line strips, an insulating body, a body in electrical connection with the earth, an intermediate body carrying insulated connecting pins, adapted to make and break connection between electric conducting line strips; an electromagnet arranged to control the intermediate body, thereby to automatically disconnect or open all wires in one route from wires in other routes, and from central office, upon the overcharging of any of them.

551,391. AUTOMATIC TELEPHONE EXCHANGE SYSTEM; William F. Lounsbury, Owego, N. Y. App. filed April 23, 1895. An automatic telephone exchange system, consisting of the combination of a given number of telephones located at respective sub-stations, independent electric conductors connecting each telephone with all the other telephones respectively, a circuit-closer in circuit with each of the said conductors, and means located at the central station, governed by devices located at the sub-station for controlling said circuit-closers in a predetermined manner.

551,394. ELECTRIC LIGHT; David Misell, New York, N. Y. App. filed April 5, 1895. The combination of a battery with a frame mounted thereon, a revoluble toothed barrel hung in the frame, and having an upwardly projecting spindle, radial arms connected to said spindle, a reed plate engaged by the barrel, an incandescent filament supported above the spindle and having a downwardly extending contact wire that is adapted to be engaged by the radial arms, and with battery wires going to the filament and to the spindle.

551,427. HEAT REGULATOR; William W. Wilcox, Westerly, R. I. App. filed April 6, 1895. In a heat-regulating apparatus, a movable receptacle for liquid operatively connected to heat-controlling valve or damper, a liquid supply for said receptacle, thermostatic means for controlling the flow of liquid into said receptacle and distinct thermostatic means for controlling the escape of liquid from said vessel, all combined.

551,436. ELECTRIC METER; Thomas Duncan, Fort Wayne, Ind. App. filed July 11, 1895. The combination, with an electric meter, of a vertical spindle carrying an armature and retarding fans, a vertical post adjustable in its bearings, and having a jewel setting in a removable part at its upper end, upon which the said spindle rotates, and a cup-shaped nut surmounting or covering said jewel and adjustable upon the said vertical post.

551,451. ELECTRIC LIGHTER; Herbert E. Rider and John Hencken, New York, N. Y. App. filed Nov. 10, 1894. The combination with a torch of a receptacle for the same, and an electric spark-forming device, said device being actuated by the withdrawal of the torch to form a spark, but being unaffected by restoring the torch.

551,470. CONTROLLING ELECTRIC MOTORS; David Mason, Schenectady, N. Y. App. filed April 22, 1892. The combination of two or more electric motors, a series-multiple switching device for controlling said motors, and means for opening the circuit of the armature of one motor while the connections are changing from series to multiple arc.

551,504. CABLE HANGER; Sylvester S. Leonard, Chicago, Ill. App. filed Aug. 8, 1895. The combination with a cable of a suitable hanger, a pin journaled in said hanger, a strip of metal encircling the cable, said strip

adapted to be wound up by the pin and suitable means for locking the pin in place.

551,515. TELETYPER; Charles Spiro, New York, N. Y. App, filed Aug. 14, 1895. A pivotally mounted ball, a pinion carried thereby, a key lever and an arm carried thereby normally out of engagement with said pinion, and signal-transmitting devices operatively connected with the key lever.

551,534. CLOSED CONDUIT ELECTRIC RAILWAY SYSTEM; Frederick C. Esmond, Brooklyn, N. Y. App. filed April 12, 1895. The combination of a main supply conductor, working conductor sections normally out of circuit with the supply conductor, electromagnetically operated switches for coupling the working sections in circuit with the main conductor, and collectors on the car overlapping one another in a fore and aft direction, for establishing a circuit through the pick-up magnet of an advance conductor section.

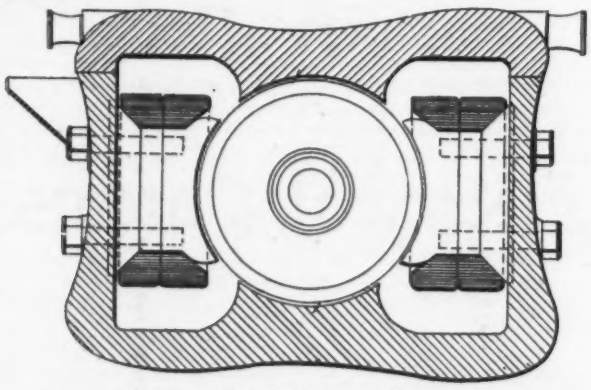
551,535. CLOSED CONDUIT RAILWAY SYSTEM; Frederick C. Esmond, Brooklyn, N. Y. App. filed April 12, 1895. The combination of line conductors and working conductor sections with a switch or set of switches normally disconnecting the line conductors from the contact sections, but connecting the sections constituting each pair through a magnet; collectors traveling with the car, and means for forming a circuit through the magnet by the collectors, and thereby throwing the magnet into line circuit.

551,536 CLOSED CONDUIT ELECTRIC RAILWAY SYSTEM; Frederick C. Esmond, Brooklyn, N. Y. App. filed April 26, 1895. The combination in an electric railway of a supply conductor, working conductor sections or points arranged in sets of three, double collectors arranged as described, and a battery or other source of current adapted to be connected to the different collectors.

551,537. CLOSED CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; Frederick C. Esmond, Brooklyn, N. Y. App. filed Sept. 11, 1895. The combination of an insulated supply conductor, a series of collectors on the car, and a series of working conductor sections divided into sets of three and arranged along the line of travel, with a space between each set substantially equal to the distance which can be bridged by two of the collectors.

551,551. HOLDER FOR TELEPHONE RECEIVERS; W F. Martland, Fall River, Mass. App. filed June 10, 1895. A holder for telephone receivers, comprising a spring-pressed rod fitted to slide, and connected with the telephone switch, an arm pivotally connected with the said rod and adapted to carry the receiver, and a segment for holding the said arm in any desired inclined position, to bring the receiver close to the ear of the user.

551,565. PROCESS OF RENOVATING STORAGE BATTERIES; John Trowbridge, Cambridge, Mass. App. filed Oct. 1, 1895 The method of renovating lead storage batteries or accumulators, which consists in charging the cell, removing the negative lead elements from the cell, replacing them by an amalgamated zinc element and then discharging the storage battery or accumulator.



No. 551,567.—ELECTRIC MOTOR.

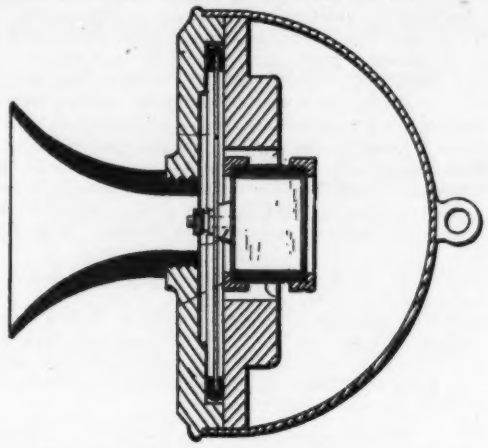
551,567. ELECTRIC MOTOR; Merle J. Wightman and Oscar C. G. Urban, Cleveland, O. App. filed May 16, 1893. An electric motor having a pole-piece constructed in two sections, the rearward or outer section whereof is removable, whereby the inner section thereof is capable of being moved outwardly or backwardly from the armature. (See Illustration.)

551,587. ELECTRIC RAILWAY; Rudolph M. Hunter, Philadelphia, Pa. App. filed Feb. 23, 1887. In an electrically propelled vehicle, the combination of the vehicle structure, two electric motors, one arranged adjacent to and adapted to rotate each of the two axles, a current-collecting device carried by the vehicle, and a motor circuit leading from the current-collecting device to each motor, whereby they are coupled in parallel.

551,633. ELECTRIC MOTOR; Frank C. Herdman, Winnetka, Ill. App. filed Aug. 6, 1894. In combination, an electric motor, a source of current supply, electrical connection between the field and current source, an arm adapted in its movement in one direction to decrease the amount of current in the field, and in the other direction to increase the current in the field, an operating bar, intermediate connections between said arm and said bar, and means independent of said operating bar to move said arm in both directions.

551,634. MECHANISM FOR ADMISSION AND REGULATION OF CURRENT TO MOTORS; Frank E. Herdman, Winnetka, Ill App. filed March 29, 1895. In combination with a source of current supply, a motor and circuit connections to the field and armature of said motor resisting in both circuits, a device adapted in its movement in one direction to increase the current in the armature circuit and decrease the current in the field circuit, actuating mechanism adapted to move said device to increase the current in the armature circuit and decrease the current to the field, and mechanism adapted to act against said actuating mechanism and move the said device in the opposite direction.

551,635. MECHANISM FOR ADMISSION OF CURRENTS TO MOTORS AND REGULATION OF CURRENTS IN SAME; Frank E. Herdman, Winnetka, Ill. App. filed June 28, 1895. In combination with a source of current supply, a translating device, circuit connections to said translating device and operating mechanism, of a device in its movement adapted to vary the current's strength in the circuit to the translating device, a solenoid adapted when energized to move said current regulating device in one direction and mechanism connected with the operating mechanism, and adapted by the movement of the operating mechanism to move the core of the solenoid, and said last-mentioned device in the opposite direction, a switch device independent of the translating device, switch controlling the current to the solenoid, and means to open said switch device in the last-mentioned operation of the operative mechanism.



No. 551,674.—TELEPHONE TRANSMITTER.

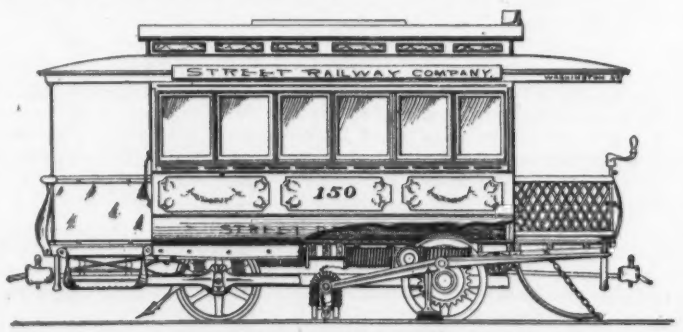
551,664. ELECTRIC RAILWAY MOTOR SHIELD; I. F. Baker and W. R. McLain, Lynn, Mass. App. filed Nov. 25, 1895. The combination in an electric railway car, of a propelling electric motor sustained or supported beneath the body of the car, as described, and a protective pan or shield formed in jointed sections and sustained between the motor and the ground, and suitable fastening devices for detachably securing the free end of the pan in elevated position.

551,674. TELEPHONE TRANSMITTER; Theodore Grissinger, Mechanicsburg, Pa. App. filed Oct. 18, 1894. In a telephone transmitter, the combination of a granulated conducting medium, a vibrator adapted to agitate said conducting medium in accordance with sound vibrations, a casing for the conducting medium and vibrator, and means for conducting an electric current laterally through the granulated conducting medium, and at a right angle to the movements of the vibrator. (See Illustration.)

551,682. ELECTRIC LOCK; Philip Meyer and Julius A. Meyer, Newark, N. J. App. filed Feb. 23, 1895. The combination with the lock case of a pivotal bolt head, independent latches adapted each to operate said bolt head, and an electromagnet, its armature and connections, also adapted to operate said bolt head when said magnet is energized.

551,712. DYNAMOELECTRIC MACHINE: Alexander B. Blackburn and William Buchannan, Wolverhampton, England. App. filed Oct. 1, 1895. A dynamoelectric machine in which an exciting coil, is combined with two or more armature coils and sets of laminated magnetic material, some embracing one armature coil and some another, and an inductor having projections to close the magnetic circuits successively whereby there is little or no fluctuation in the number of lines through the exciting coil.

551,734. TRANSMISSION OF ELECTRICITY TO MOVING CARS; Thomas Nesom, Indianapolis, Ind. App. filed Sept. 21, 1894. In a system for transmitting electricity to a moving car, a box containing feed wires, a conduit holder placed above such box in sections, an insulating block between such sections, a conduit in such conduit holder, a line conductor within such conduit, and connecting wires from the feed wires extending through such insulating blacks to the line conductor. (See Illustration.)



No. 551,734.—TRANSMISSION OF ELECTRICITY TO MOVING CARS.

551,743. SYSTEM FOR REGULATING EFFECTIVE TENSION OF ELECTRICAL CIRCUITS; Herman Otto Wilhelm Justus Breul, Berlin, Germany. App. filed Nov. 17, 1893. The combination with a consumption circuit, of a number of feeding conductors connected therewith, means for increasing or decreasing the electromotive force impressed upon the several feeding conductors, and a device responsive to the reversal of current in a feeding conductor.

Electro-Therap.

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28 DEC 1895

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AN ILLUSTRATED WEEKLY REVIEW OF CURRENT Progress IN Electricity AND ITS PRACTICAL APPLICATIONS

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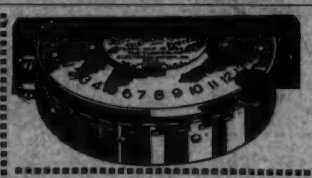

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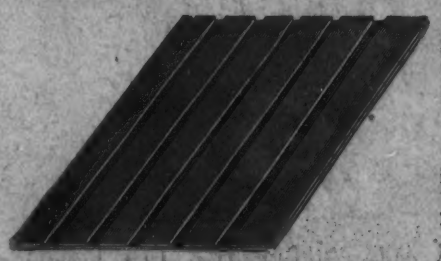

Patent Grooved Belting having Groove running lengthwise of the Belt, serve as channels to permit the escape of air between Belt and Pulleys, to such a degree that the air cushion is overcome and the Belt can be run very slack, thereby taking the heavy strain from the bearings.
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BOSTON, MASS., 164 Summer St., G. J. Kelley, Manager.
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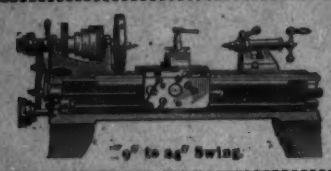

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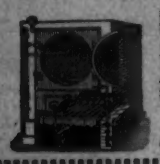

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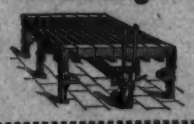

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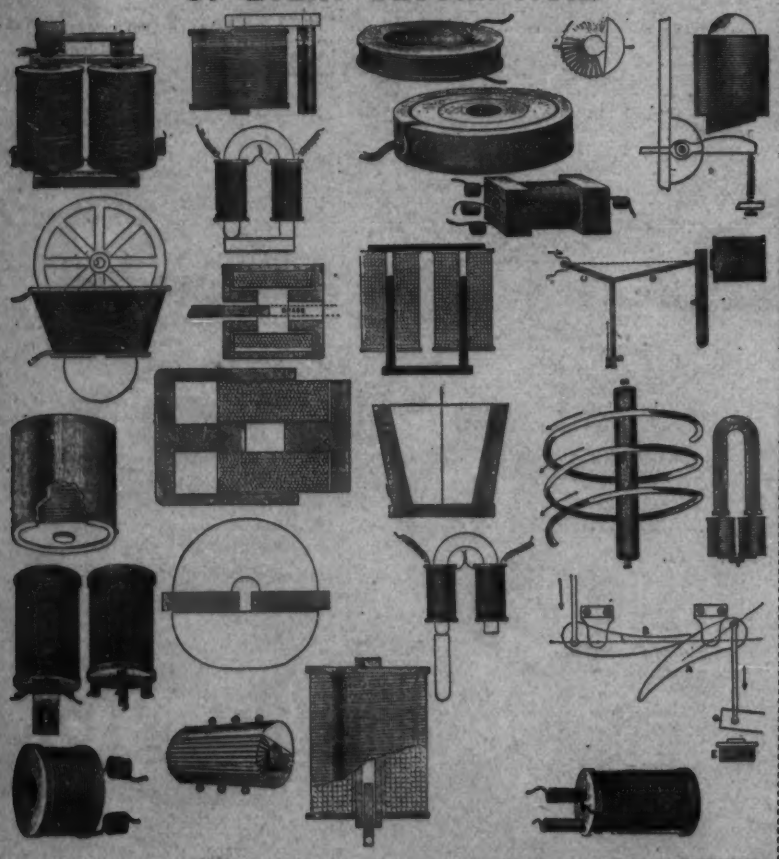

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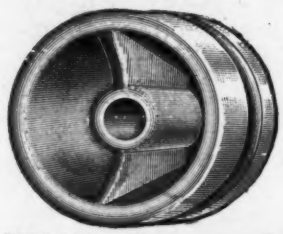

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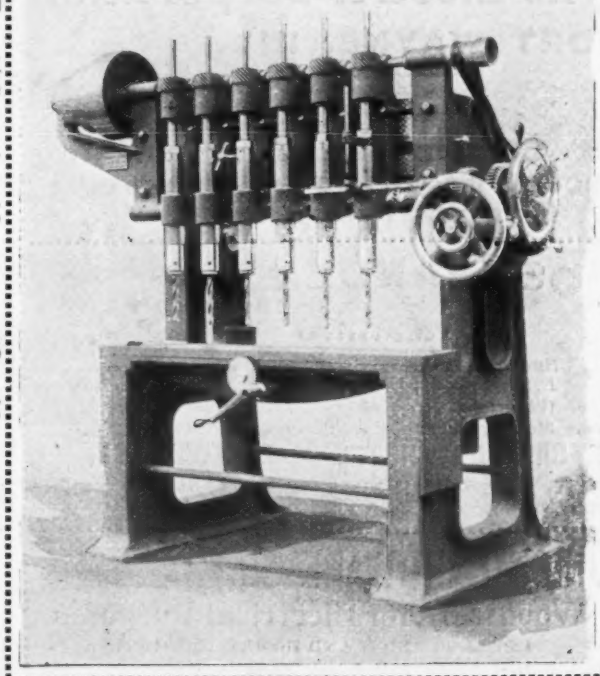

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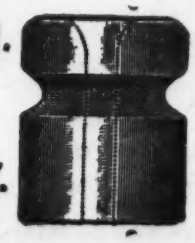

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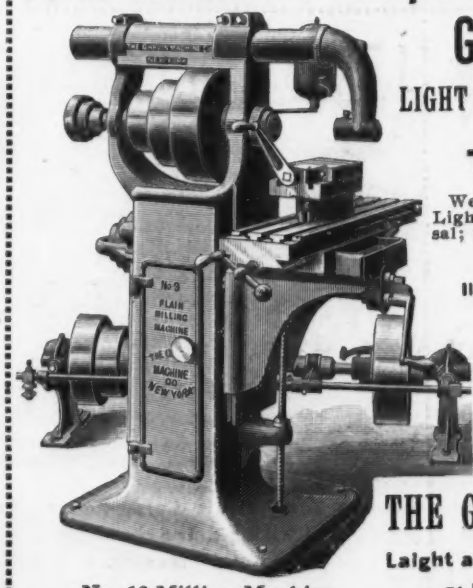

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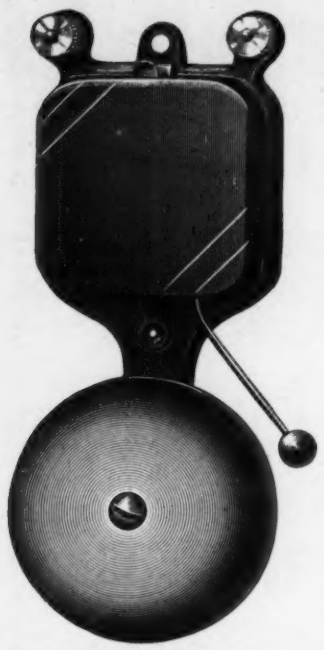

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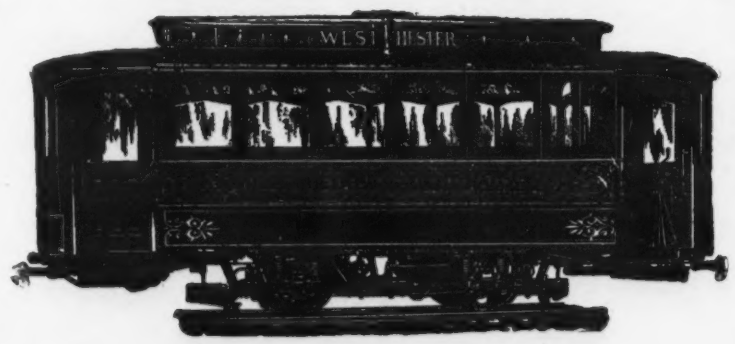

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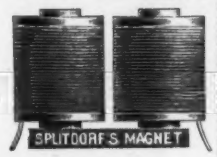

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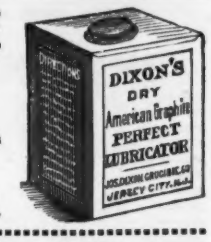

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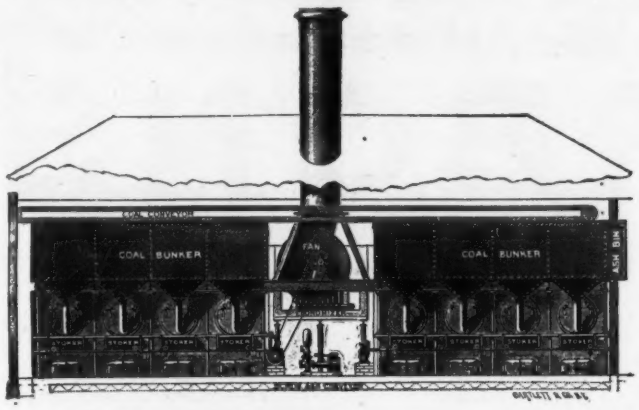

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SOMETHING TO THINK ABOUT.

A hot fire gets the most heat out of the coal.

When you have a hot fire under a boiler and a low stack temperature your coal is making lots of heat and you are using it.

Don't be deceived into thinking your economy is good merely because the stack temperature is low.

Sometimes a high-stack temperature is economical because the greater economy of a hot fire more than makes up for the loss through the stack.

WHAT TO DO.

Get the hottest fire you can out of your coal through perfect combustion.

Get the lowest stack-temperature possible by sending the heat into the water, not up the stack.

To do this, mechanical stoking is necessary in making a hot fire and keeping it hot all the time.

An economizer and mechanical draft plant is necessary to utilize the surplus heat which the boiler will not take up.

TO ANSWER SOME POSSIBLE QUESTIONS.

The stoker feeds coal uniformly, burns it clean, and in fact is a first-class fireman who performs his duty without opening doors. The labor saving in many cases exceeds the direct fuel saving.

The economizer puts the waste heat into the feed water, increasing its temperature 100 degrees or more, and every 10 degrees rise saves 1 per cent. of coal.

The mechanical draft supplies a sufficient draft independent of the stack, which may be merely high enough to clear the roof and enables more heat to be put into the economizer than with natural draft.

The cost of the economizer and mechanical draft rarely exceeds that of a sufficient stack.

The economizer and mechanical draft go naturally together, though either may be used independently of the other. The economizer when used alone requires a high stack to give ample draft; the mechanical draft when used alone has the fan fitted with water boxes suitable for the high temperature resulting from absence of the economizer.

IN GENERAL.

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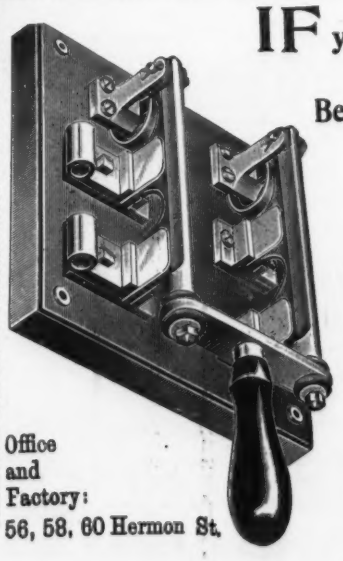

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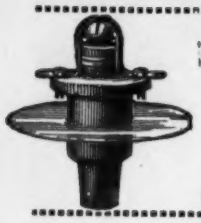

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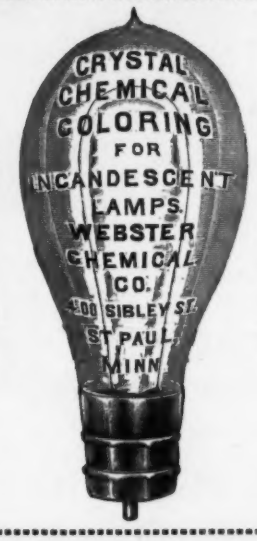

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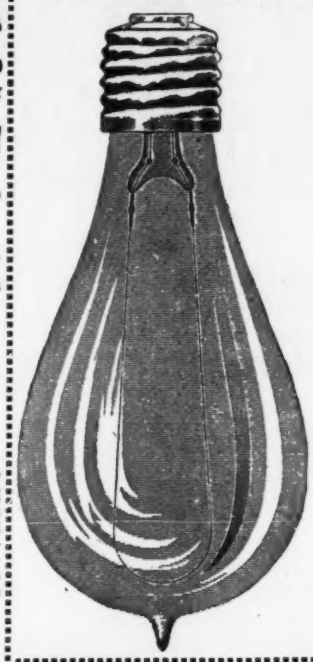

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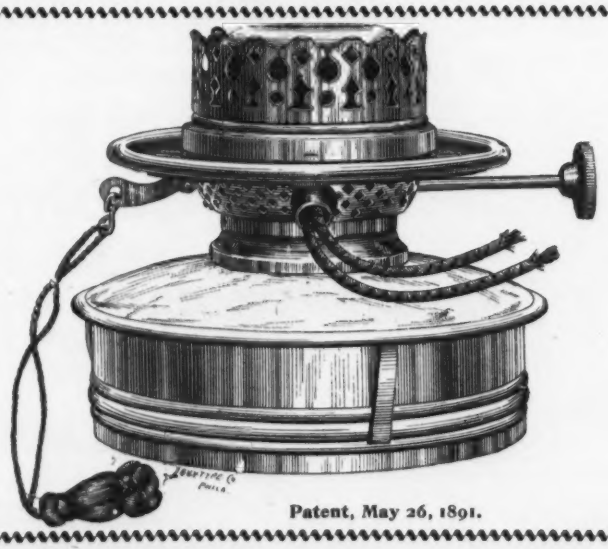
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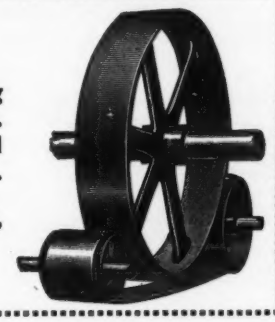

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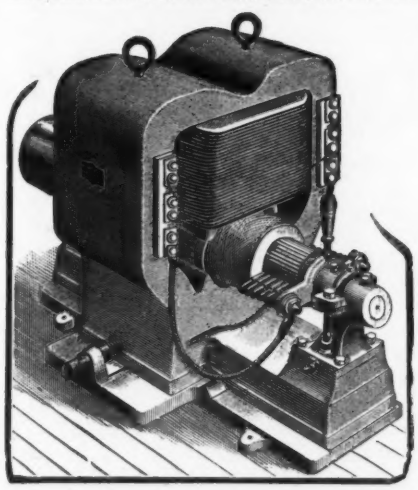

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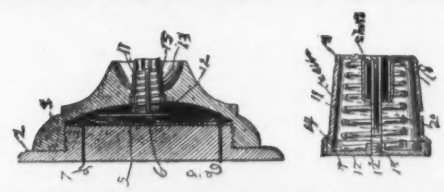

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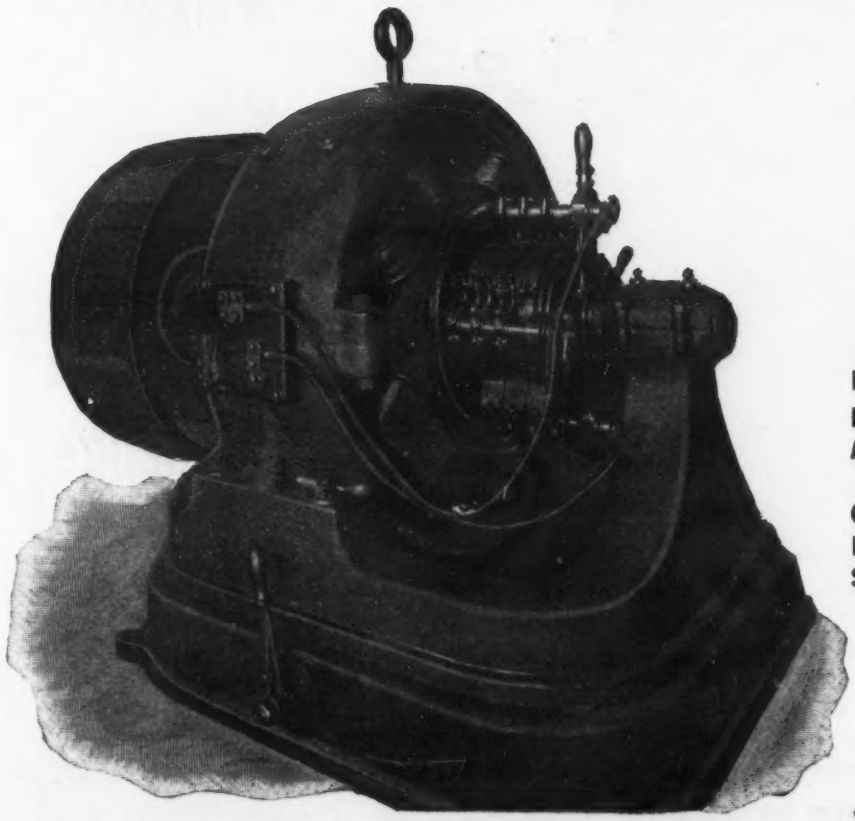

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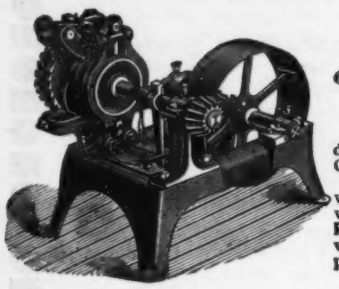

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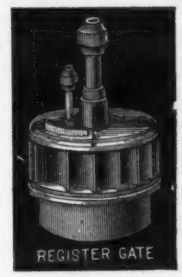

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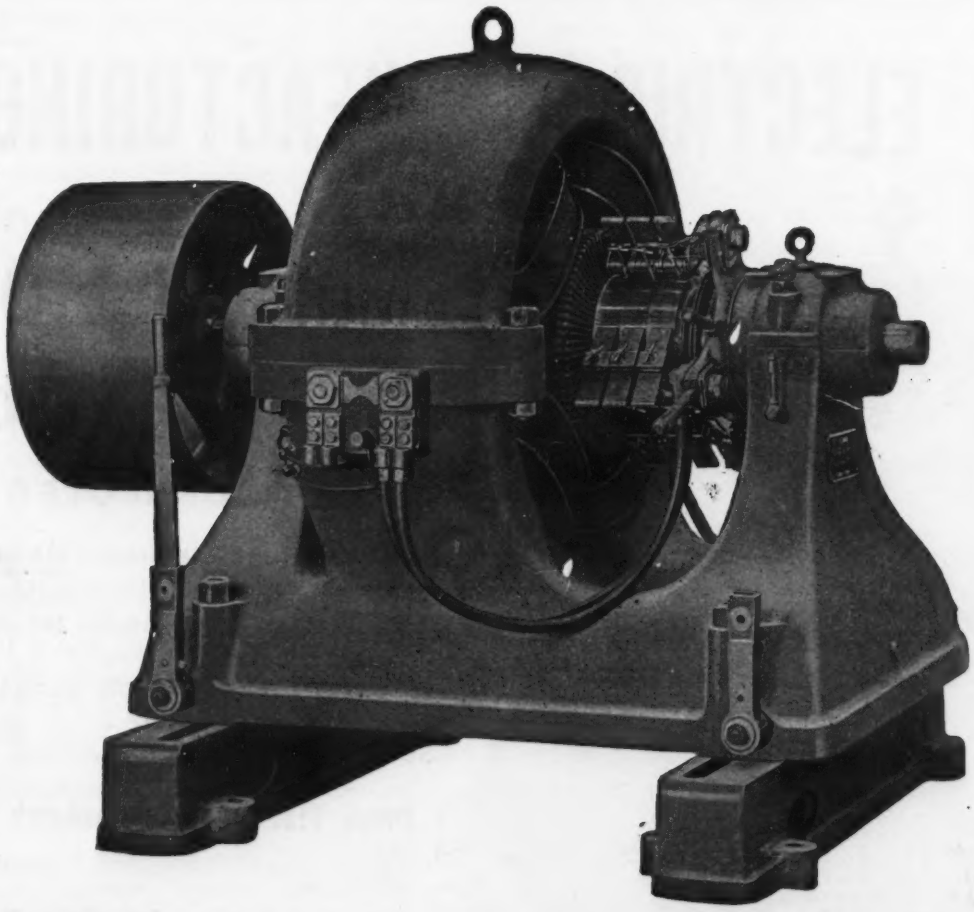

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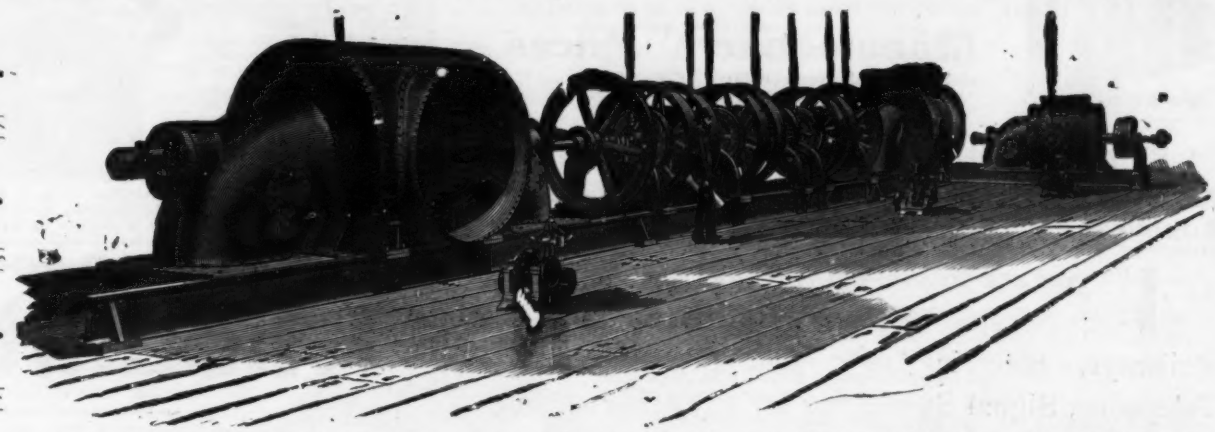

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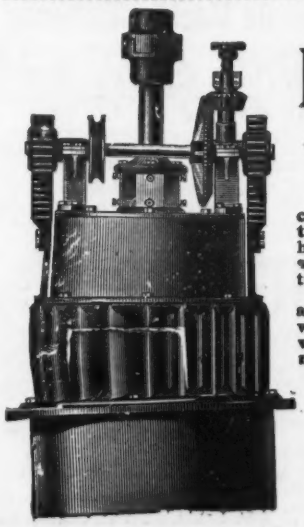

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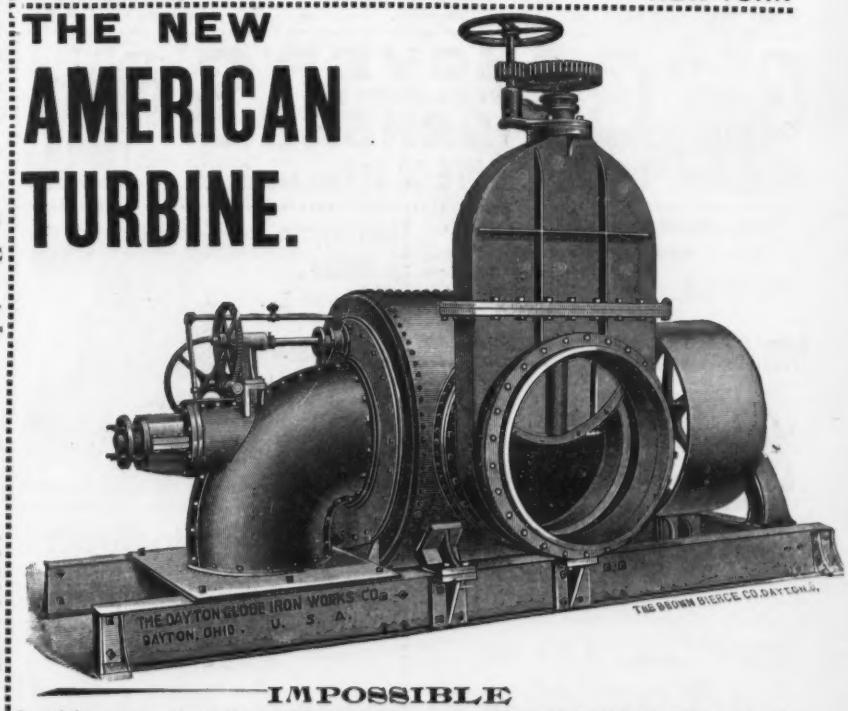

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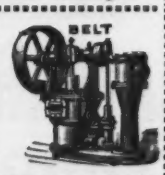

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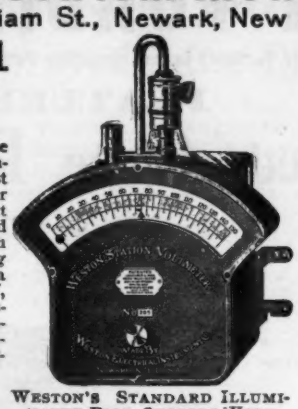

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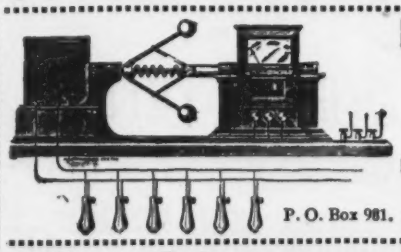

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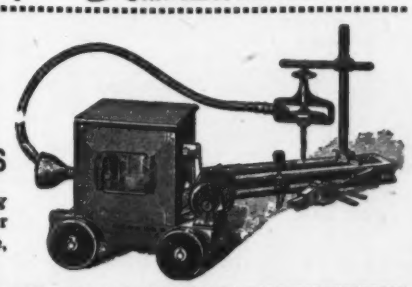

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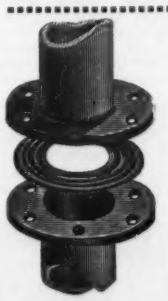

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DIRECT CURRENT DYNAMOS.—2 45-Kw. Edison, $550 each. 2 30-Kw. Edison, $450 each. 1 25-Kw. Edison, $375. 1 600-light Westinghouse, $425. 1 375-light Westinghouse, $325. 1 300-light Westinghouse, $250. 2 3-Kw. Edison, $120 each. Above are all 110 volts in first-class condition.

MOTORS.—1 15-HP 220 volt T.-H., $275. 2 15-Kw. 220 volt Edison, $225 each. 2 3-Kw. 220 volt Edison, $120 each, besides a large number of others of all voltages and different makes.

It will give us pleasure to furnish lists (as the above is by no means complete) and any other information to prospective customers.

Rossiter, MacGovern & Co.,
141 Liberty St., - New York City.

Knife Switches.

25	Amp.	Single	Pole,	Polished	Base,	Net,	$0.50
50	"	"	"	"	"	"	.65
75	"	"	"	"	"	"	1.00
25	"	Double	"	"	"	"	.60
50	"	"	"	"	"	"	1.10
75	"	"	"	"	"	"	1.50
25	"	Triple	"	"	"	"	1.25
50	"	"	"	"	"	"	1.75
75	"	"	"	"	"	"	2.00

We carry a line of general supplies. Write for Prices when in the Market.

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The Reliance Safety Water Columns, by causing the water to be carried steadily at the proper level, increase the durability of the boilers and reduce the cost of maintenance and operation. The saving aggregates many times their cost. Do you use them? Let us give you an estimate.

THE RELIANCE GAUGE CO.,
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FOR SALE—30 W. P. Electric Motors, Form F., General Electric, 220 volts, 30 horse power, practically new, majority never been used; suitable for power, illumination and low voltage car plant, by METROPOLITAN RAILROAD CO.,
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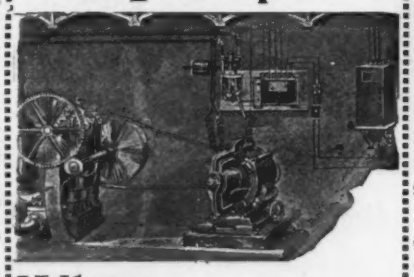

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Bear in mind the Possibilities of Electric Pumping

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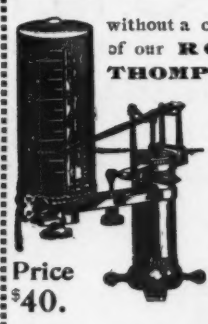

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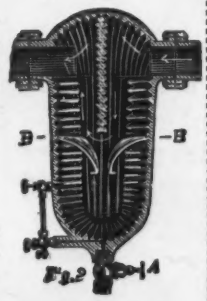
Price $40.

OIL in the Cylinder and **WATER** in the boiler are proper, but reverse these conditions and you are in great danger.

The HINE... ELIMINATOR

has a great record; better look into it if you are troubled.



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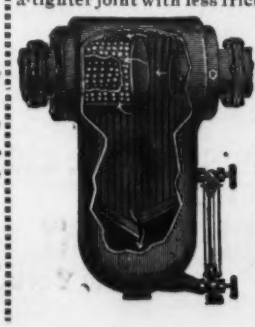

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7-M.	50 Hour R.	$	5.00 Each.
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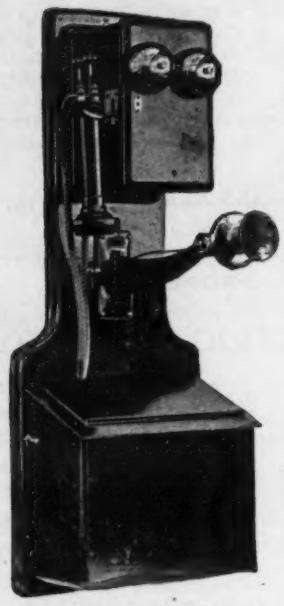

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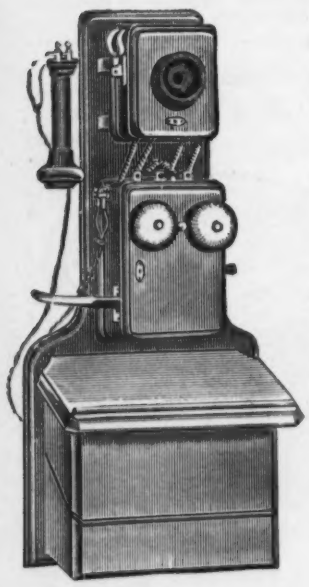

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Dec. 25, 1894.
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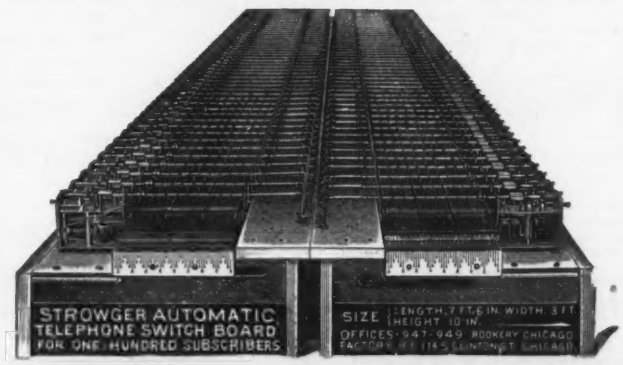
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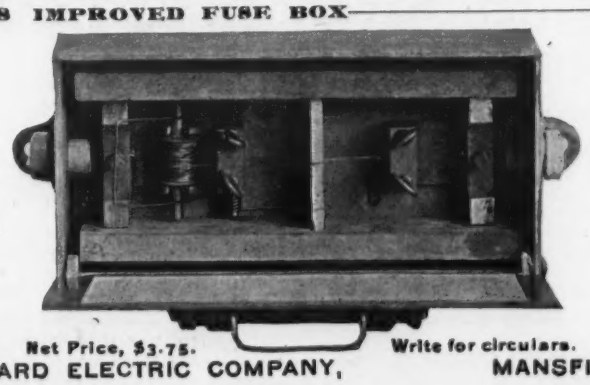

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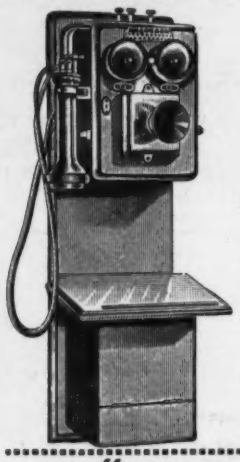

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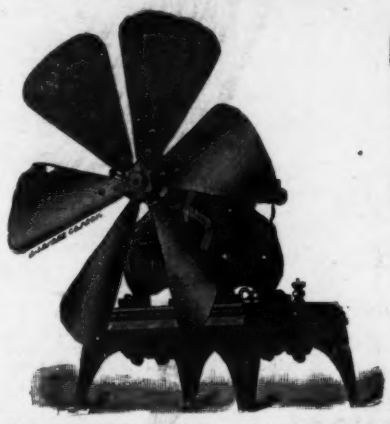

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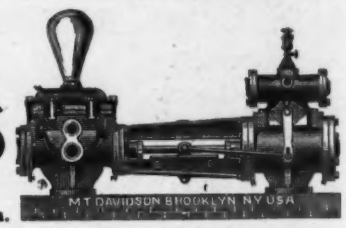

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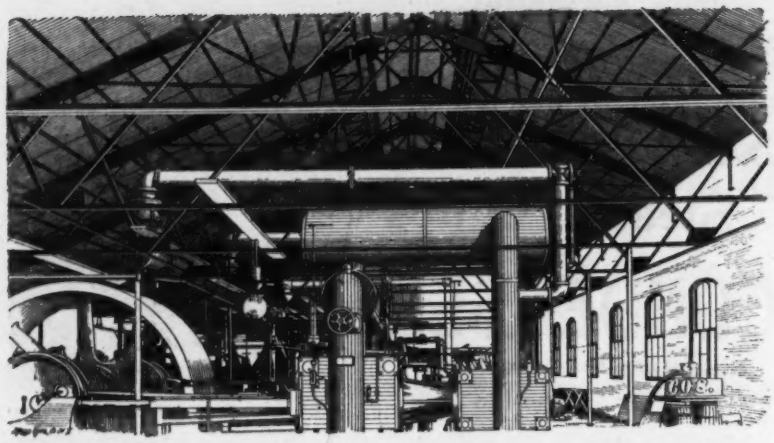

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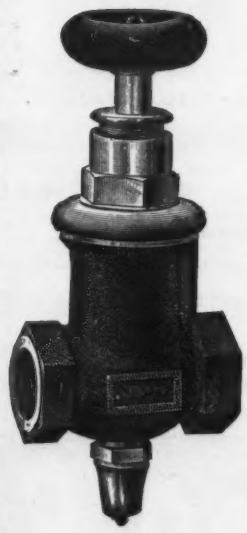

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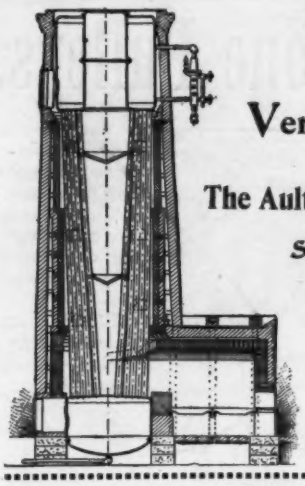

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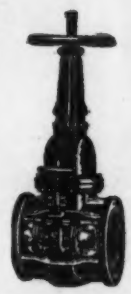

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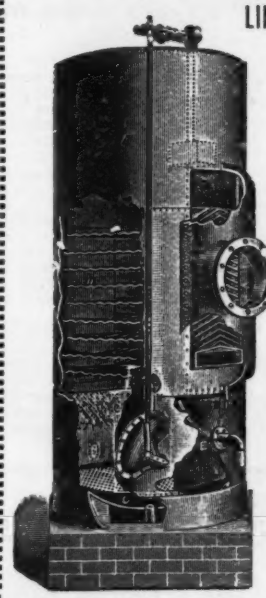

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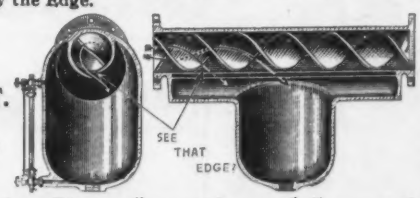

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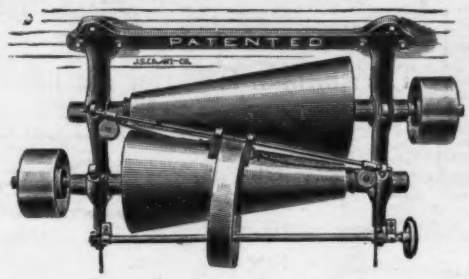

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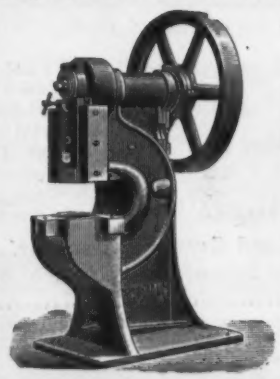

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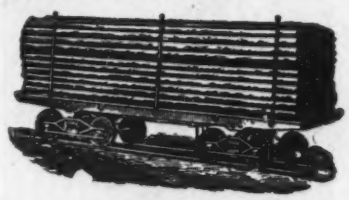

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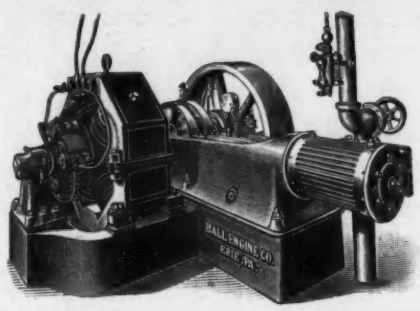

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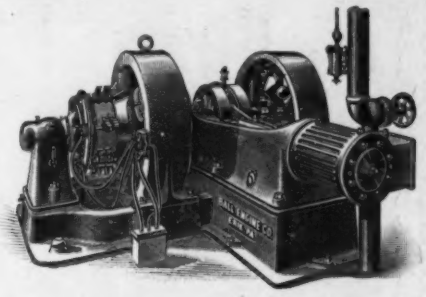

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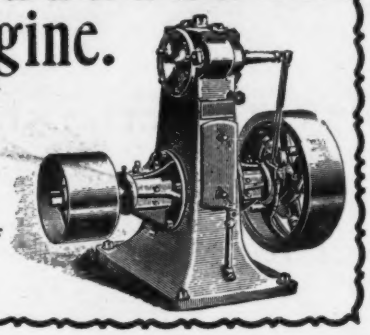

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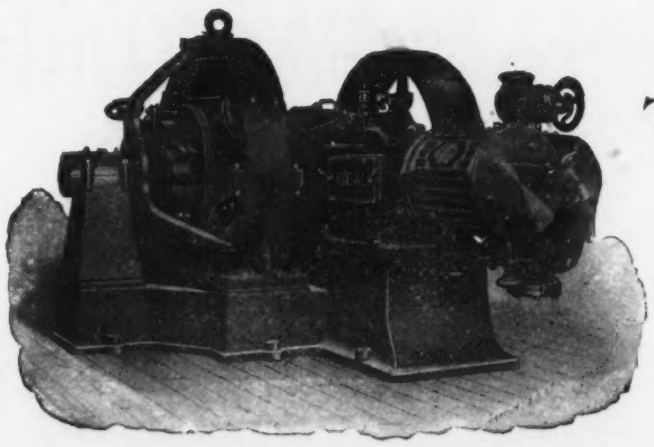

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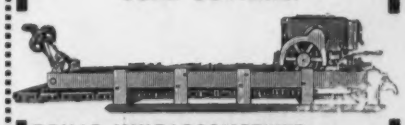

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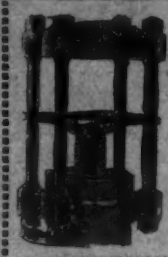

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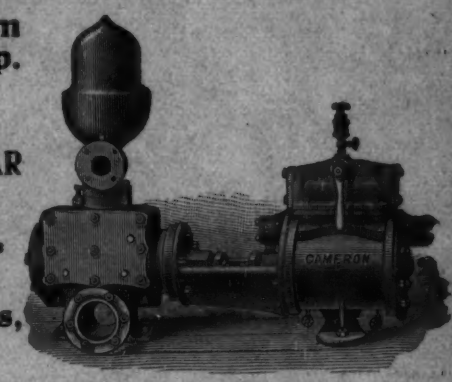

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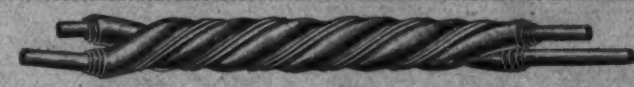

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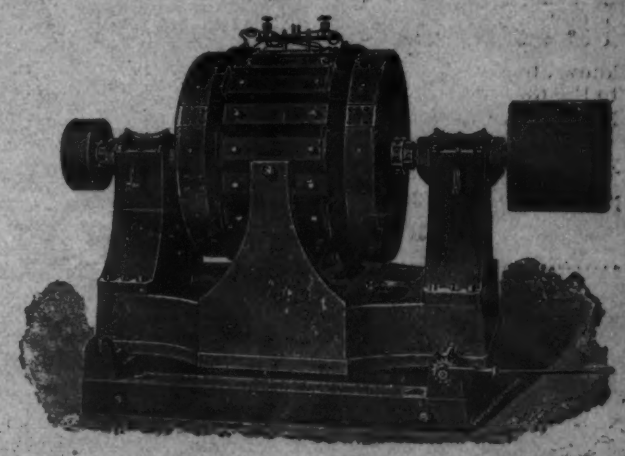

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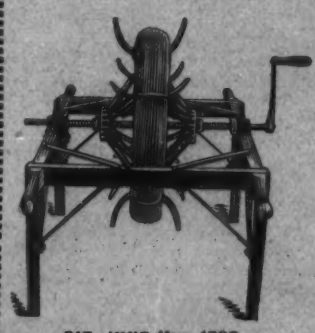

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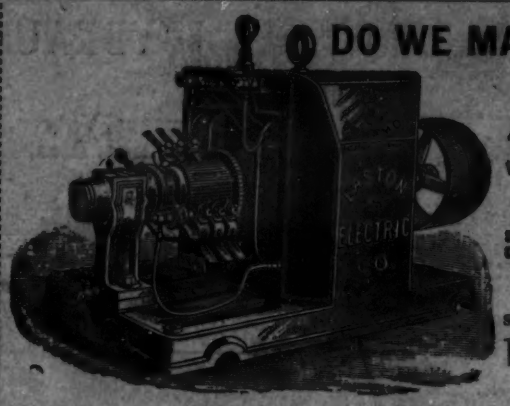

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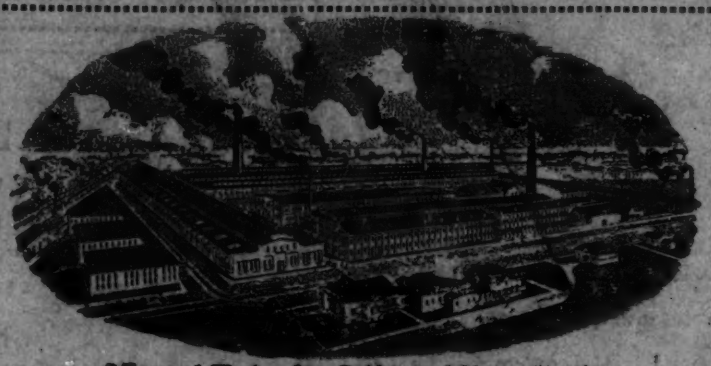

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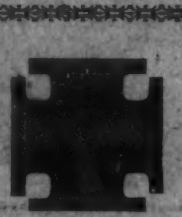

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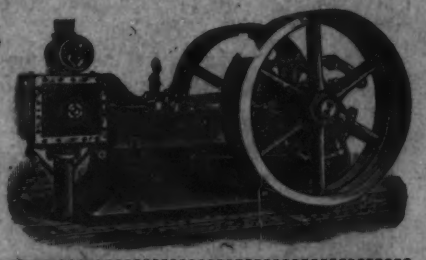

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